ANSI
X4.7-1973
Revision of
X4.7-1966

American National Standard for Typewriter Keyboard Arrangement

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Secretariat

Computer and Business Equipment Manufacturers Association

Approved March 14, 1973

American National Standards Institute, Inc

American National Standard

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Foreword

(This Foreword is not a part of American National Standard for Typewriter Keyboard Arrangement, X4.7-1973.)

This revision of American National Standard Typewriter Keyboards, X4.7-1966, is intended to reflect the user requirement for a 44-key typewriter keyboard arrangement. Two more keys (four characters) have been added to the Electric Typewriter Keyboard Preferred Arrangement in American National Standard X4.7-1966 to meet the user requirement for a standard typewriter keyboard that can accommodate a greater number of applications regardless of the business area in which it is placed.

As evidenced by the successful adoption of American National Standard X4.7-1966 and the subsequent user preference for the de facto 44-key typewriter keyboard arrangement, keyboard arrangement standardization benefits both user and manufacturer. The greatest benefit to the user occurs in the areas of operator training, purchasing, and interchangeability of machines and operators.

Over a period of many years, schools for training operators, and countless numbers of operators themselves, have been oriented to the keyboard arrangement described in this standard.

Suggestions for improvement of this standard will be welcome. They should be sent to the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

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American National Standard for Typewriter Keyboard Arrangement

1. Scope and Purpose

1.1 Scope. This standard describes the arrangement of the 44 basic printing keys on the typewriter and the characters, uppercase and lowercase, that appear on the keys. It also includes the two shift keys and the space bar. However, the standard does not specify the physical characteristics and dimensions of the keys and keyboard. It relates to the keyboard arrangement only.

1.2 Purpose. The purpose of this standard is to provide the greatest benefit to the user in the areas of operator training, purchasing, and interchangeability of machines and operators.

2. Definitions

In this standard, the following definitions shall apply:

alphabetic. Pertains to the letters in an alphabet.

alphanumeric. Pertains to the alphabet and the numerals that comprise a complete set for a particular language.

case. A group of characters similarly positioned with respect to the shift.

functional key. The key on the machine which, when activated, produces a machine action other than a printing impression, such as space, shift, backspace, etc.

key (key top, key button). A finger-contact member, the activation of which results in a machine response.

keyboard. The area of a machine on which the printing and functional keys are arrayed.

keyboard arrangement. The position of the keys relative to one another and the arrangement of characters on them.

lowercase. A group of characters, usually containing the small alphabet, numerals, and certain symbols, that are in printing position with the shift key in its customary position (not depressed).

numeric. Pertains to arabic numbers.

printing key. A key on the machine, the activation of which results in a printing impression.

shift. The facility to change from one case to another.

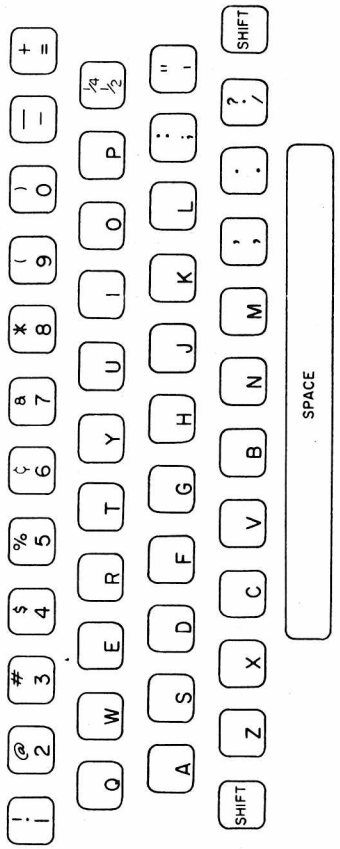
symbol. Any of the punctuation marks and signs used instead of a word or words to represent an operation, relationship, spoken sound, etc.

uppercase. A group of characters, usually containing the capital alphabet and certain symbols, that are brought into printing position by depressing the shift key.

3. Standard Keyboard Arrangement

3.1 Fig. 1 shows the standard arrangement of the keys and the characters assigned to them (including the two shift keys and the space bar).

3.2 In Fig. 1, the keys labeled with the letters of the alphabet are intended to produce lowercase letters in unshifted (lowercase) mode and uppercase letters in the shifted (uppercase) mode. The other keys are intended to produce the lower character as shown in the key in the unshifted mode, and the upper character as shown in the key in the shifted mode.



NOTE: Physical characteristics and locations (that is, size, shape, skew, etc) of the space bar or of the keys are not to be inferred.

Fig. 1
Typewriter Keyboard Arrangement

Appendix

(This Appendix is not a part of American National Standard for Typewriter Keyboard Arrangement, X4.7-1973, but is included for information purposes only.)

Criteria for Addition of Characters to Keyboard Arrangement

A1. Introduction

This Appendix contains the criteria and other considerations that were used in revising American National Standard Typewriter Keyboards, X4.7-1966.

A2. Criteria

A2.1 The keyboard arrangement should have maximum resemblance to the Electric Typewriter Keyboard Preferred Arrangement contained in American National Standard X4.7-1966.

A2.2 The additional keys to be added should be located in the "touch-type" area.

A2.3 The additional characters to be added should be those that have the greatest utility across the wide variety of applications in which typewriters are used in the business environment.

A3. Discussion of Criteria

A3.1 The increasing acceptance of the electric typewriter in the home, in educational institutions, and in the general business office environment by users was the prime consideration in the decision to adopt the Electric Typewriter Keyboard Preferred Arrangement given in American National Standard X4.7-1966 for inclusion in this standard. The survey of both American and foreign electric typewriters marketed in the United States substantiated the user preference not only for the basic 42-key character arrangement but also for the de facto 44-key character arrangement of the electric typewriter keyboard.

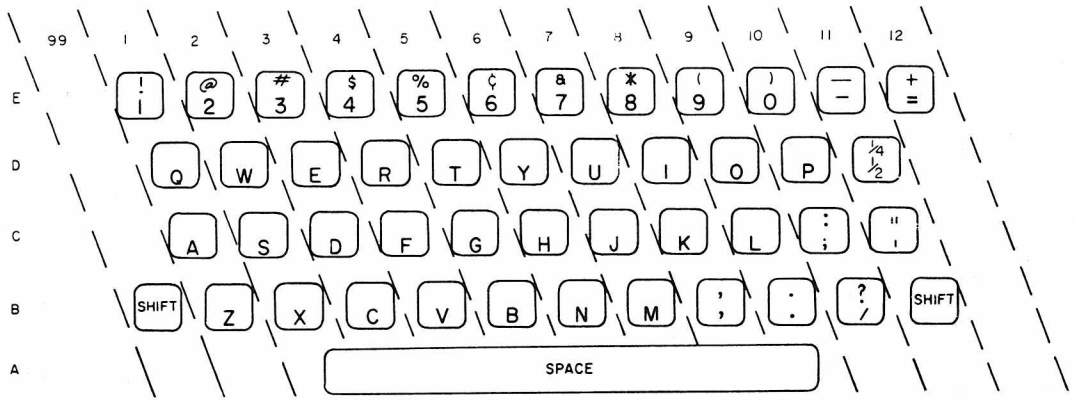
A3.2 The placement of the two additional keys (E1 and E12) was based upon the experience gained over the last 5 years as to the acceptance of these locations by users. Placing the two keys to the left and right of the "E" row puts them in the "touch-type" area and provides for a balanced keyboard.

A3.3 The characters selected (!, 1, +, and =) to be placed on the two keys (E1 and E12) are those which have had the greatest user acceptance in major typewriter application areas.

A3.3.1 The increasing need in many applications for a numeral "1" that is clearly distinguishable from the small letter "l" dictated that it be placed in the lowercase position of key E1. As Optical Character Recognition equipment becomes more sophisticated, it can be anticipated that it will someday easily read ordinary typewritten copy involving normal, non-stylized type styles.

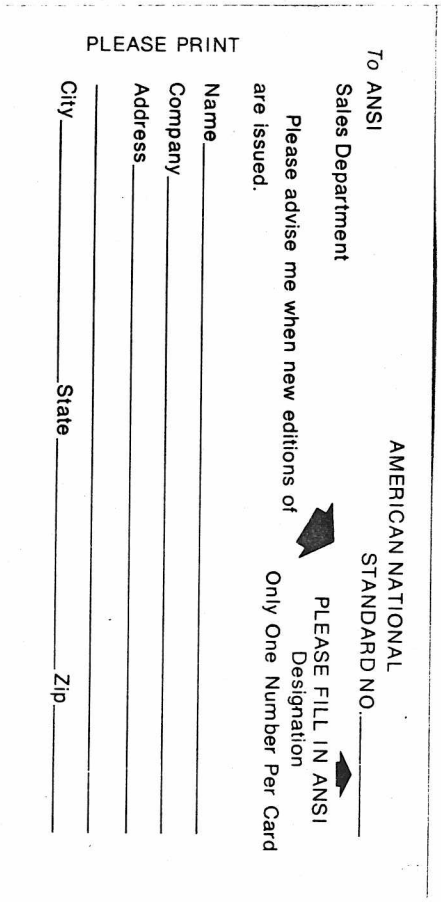
A3.3.2 The placement of the + and = characters on key E12 follows human factor practices; that is, these characters are normally used as arithmetic operators, hence they should be located adjacent to the numerals. The = character was placed in the lowercase position because it is used more frequently than the +.

A3.3.3 The remaining open position (uppercase E1) dictated the placement of the exclamation point. As with the placement of other standard characters, the accessibility factor has also been taken into consideration in choosing the various combinations. The more frequently used characters should, whenever practical, be placed in the lowercase position, whereas the less frequently used character is placed in the less accessible shift position.



NOTE: The positional notation system used here is intended for easy reference to indicate positions on which characters are placed. The system is that being recommended by the International Organization for Standardization and is being used here on a trial basis. It is not intended to be part of this standard.

Fig. A1
Typewriter Keyboard Arrangement
with Positional Notation System



ANSI
X4.14-1971

American National Standard Alphanumeric Keyboard Arrangements Accommodating the Character Sets of ASCII and ASCSOCR

Secretariat
Business Equipment Manufacturers Association

Approved March 31, 1971
American National Standards Institute, Inc

American National Standard

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Foreword

(This Foreword is not part of American National Standard Alphanumeric Keyboard Arrangements Accommodating the Character Sets of American National Standard Code for Information Interchange and American National Standard Character Set for Optical Character Recognition, X4.14-1971.)

These American National Standard arrangements are intended principally for typewriter-like data communications and data processing alphanumeric keyboards implementing the character sets of American National Standard Code for Information Interchange, X3.4-1968 (ASCII) and American National Standard Character Set for Optical Character Recognition, X3.17-1966 (ASCSOCR).

These keyboard arrangements were developed from a study of keyboards already in use by millions of trained operators in the teleprinter, typewriter, and related fields. Also taken into consideration were the American National Standard Typewriter Keyboards (ANSI X4.7-1966) and the applicable standards work being carried out internationally.

This standard was approved as an American National Standard by the American National Standards Institute on March 31, 1971.

Suggestions for improvement gained in the use of this standard will be welcome. They should be sent to the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

The Standards Committee on Office Machines, X4, had the following personnel at the time it approved this standard:

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American National Standard Alphanumeric Keyboard Arrangements Accommodating the Character Sets of American National Standard Code for Information Interchange and American National Standard Character Set for Optical Character Recognition

1. Scope

This standard specifies the assignment of the characters of the ASCII (American National Standard Code for Information Interchange, X3.4-1968) and ASCSOCR (American National Standard Character Set for Optical Character Recognition, X3.17-1966) character sets to the keys of typewriter-like keyboard arrangements.

2. Definitions

alphanumeric. A descriptive term used to define a set containing the letters of an ethnic alphabet, the digits 0 (Zero) through 9, and punctuation marks or special symbols.

control character. A functional character, as distinct from a graphic character, which is intended to facilitate information interchange by controlling or modifying the function of machines or systems. Control characters are intended to be interpreted by machines rather than by human beings and are, therefore, normally nonprinting characters. In the ASCII code table, they comprise columns 0 and 1.

control mode. The condition of the keyboard when a CONTROL FUNCTION KEY is operated. In this mode, it will cause those keys having control characters to generate their respective control code, regardless of the status of the SHIFT or SHIFT LOCK key.

function key. A key, such as the SHIFT or CONTROL key which initiates or modifies a machine function, but which does not generate or represent a coded character in American National Standard X3.4-1968.

graphic character. A character intended to be written, printed, or otherwise displayed in a form which can be read by human beings. In the ASCII code table, they comprise columns 2 through 7, excluding DEL (position 7/15). Note that *space* is considered to be a graphic character.

inboard controls. Those controls that are positioned on keys that normally contain one or both of the unshifted and shifted graphics in the ASCII code. These controls are operated in conjunction with a CONTROL FUNCTION key.

keyboard. That area of the device in which the keys associated with characters are arranged.

keyboard arrangement. The positioning of keys with relation to each other and their association with specific characters.

outboard controls. Those controls that are positioned on keys by themselves and do not operate in conjunction with a CONTROL FUNCTION key.

shifted mode. The condition of the keyboard when a SHIFT key is operated. In this mode, the alphabetic keys are associated with the uppercase letters, and other keys with the corresponding upper graphic symbol.

unshifted mode. The condition of the keyboard when the SHIFT keys are not operated. In this mode, the alphabetic keys are associated with the lowercase letters, the numeric keys with the numerals, and other keys with their corresponding lower graphic symbol.

3. Standard Keyboard Arrangements

3.1 Figs. 1 and 2 show the standard arrangements of the keys and the graphics assigned to them.

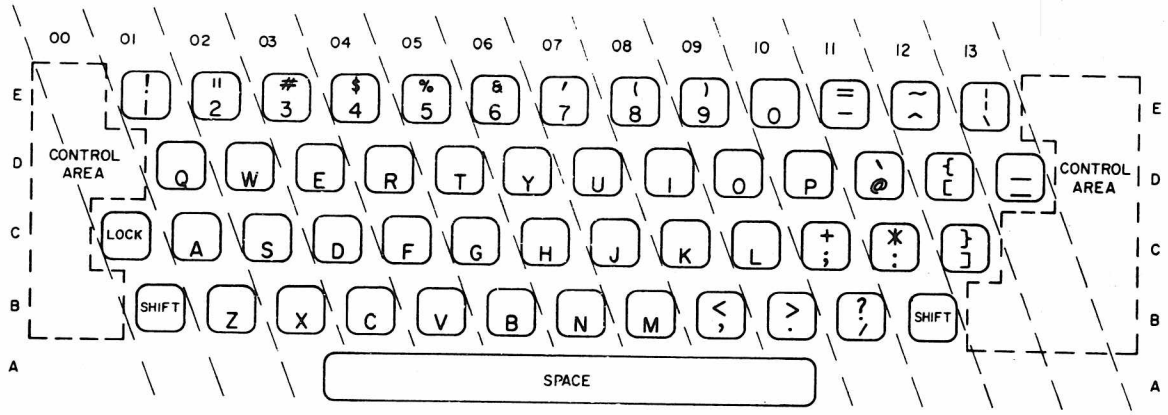


Fig. 1
Logical Bit Pairing

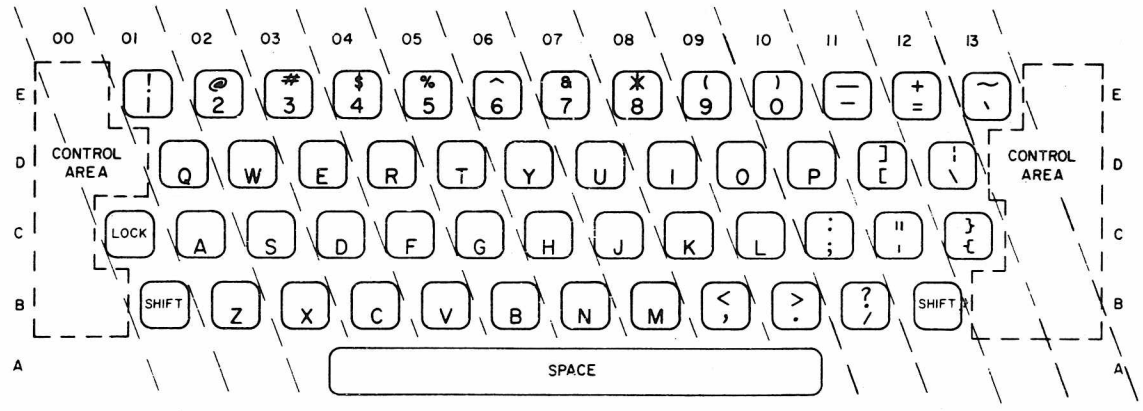


Fig. 2
Typewriter Pairing

3.1.1 In Figs. 1 and 2, the keys labeled with the letters of the alphabet are intended to produce lowercase letters in the unshifted mode and uppercase letters in the shifted mode. The other keys in Figs. 1 and 2 are intended to produce the lower graphic, as shown in the key in the unshifted mode, and the upper graphic, as shown in the key in the shifted mode.

3.1.2 When one of the two characters normally assigned to a key is omitted, the remaining character may optionally be assigned in both modes.

3.1.3 The means by which keyboards utilizing these arrangements are to encode the characters is not prescribed.

3.1.4 No standard locations are defined herein for function keys that may be required on a keyboard device, other than two SHIFT keys, one SHIFT LOCK key, and CONTROL FUNCTION key(s) which, when utilized, shall be outboard of the two SHIFT keys.

3.1.5 Inboard and outboard locations are provided for the control characters of the American National Standard Code for Information Interchange character set. The inboard control locations, in bit paired keyboards (Fig. 1), shall be on the alphanumeric keys bit paired with the characters as shown in 3.1.6. The function of the CONTROL FUNCTION key(s) is to set the keyboard in the control mode while it is operated (depressed). It will cause those keys having control character assignments (see 3.1.6) to generate their respective American National Standard Code for Information Interchange control codes, regardless of the state of the SHIFT or SHIFT LOCK key. The areas designated for outboard controls are located to the left and to the right of the alphanumeric area. The outboard control area is undefined in the exact placement of keys, because it will vary with application. Depression of an outboard key with a single control character on it will generate its respective code, regardless of the state of the SHIFT or SHIFT LOCK key. Outboard keys may have two control characters, one in unshifted mode and the other in shifted mode, providing the provisions of 3.2 are not violated.

3.1.6 If an inboard control mode is provided on bit paired keyboards (Fig. 1), the pairings shown in Fig. 3 will be observed.

3.1.7 The character DEL (delete), when used on a key by itself, shall be located in the outboard control area.

3.1.8 This standard is not intended to deprecate the assignment of a control both to a key prescribed herein and also to another key in a position not assigned in the standard arrangements.

3.1.9 A recommended location for a numeric cluster is adjacent to the most frequently used outboard controls to the right of the alphanumeric area.

3.2 The keyboard illustrated in Fig. 1 and all its permissible derivatives, as herein prescribed, shall observe logical bit pairing rules. Specifically, the code relation between the upper shift character and the lower shift character of any given key shall consist only of inversion of bit 5 or inversion of bit 6.

NUL	@	DLE	P
SOH	A	DC1	Q
STX	B	DC2	R
ETX	C	DC3	S
EOT	D	DC4	T
ENQ	E	NAK	U
ACK	F	SYN	V
BEL	G	ETB	W
BS	H	CAN	X
HT	I	EM	Y
LF	J	SUB	Z
VT	K	ESC	[
FF	L	FS	\
CR	M	GS	]
SO	N	RS	^
SI	O	US	—

Fig. 3
Inboard Control Assignments for Bit Paired Keyboards

3.2.1 In Fig. 1, key D13 produces underline in both the shifted and unshifted modes, but may optionally produce DEL (delete) in the shifted mode and underline in the unshifted mode.

3.2.2 An option which provides both uppercase and lowercase commas and periods is obtained either by excluding the characters less than and greater than, or by reassigning these two characters to two alternate locations. Examples of such an assignment would be E12, E13, D11, D12, D13, C12, or elsewhere.

3.2.3 A keyboard of fewer keys or characters than are encompassed by this standard is not in conflict with this standard, providing the position assignment of the remaining characters conforms to the following rules:

to obtain a 47 key keyboard	omit key D13
to obtain a 46 key keyboard	omit keys D13 and E13
to obtain a 45 key keyboard	omit keys D13, E13, and C12
to obtain a 44 key keyboard	omit keys D13, E13, C12, and D12

Any pair of graphic characters allocated to the omitted keys may either be omitted or may be reallocated to any one of the following keys: E12, E13, D11, D12, or C12. Any pair of characters replaced by a pair of characters from one of the omitted keys is lost. It cannot be reallocated to another key.

3.3 The keyboard illustrated in Fig. 2 resembles as closely as possible, the electric typewriter arrangement as designated in American National Standard Typewriter Keyboards, X4.7-1966.

3.3.1 A keyboard of fewer keys or characters than are encompassed by this standard is not in conflict with this standard, providing the position assignment of the remaining characters conforms to the following rules:

to obtain a 46 key keyboard	omit key E13
to obtain a 45 key keyboard	omit keys E13 and C12
to obtain a 44 key keyboard	omit keys E13, C12, and D12

Any of the graphic characters allocated to the omitted keys may either be omitted or may be reallocated to any of the following keys: E13, C12, D12, or D11. Any character replaced by a character from one of the omitted keys is lost. It cannot be reallocated to another key.

Standard 44-key arrangements may have on key D11 any two of the omitted characters from E13, D12, C12, D11, B08, or B09.

3.3.2 An option which provides both uppercase and lowercase commas and periods is obtained either by excluding the characters less than and greater than, or by reassigning these two characters to an alternate location(s). Examples of such an assignment would be E12, E13, D11, D12, D13, C12, or elsewhere.

3.3.3 The specified locations for the six characters of the American National Standard Character Set for Optical Character Recognition, X3.17-1966, in Fig. 2 that are not in ASCII are as shown in Table 1

3.3.4 To provide complete compatibility with the preferred keyboard arrangement specified in American National Standard X4.7-1966, an optional arrangement of Fig. 2 provides these substitutions: ¢ for ^ on E06, 1/4 for] on D11, and 1/2 for [on D11. It is noted that no codes exist for the three substitute graphics in the ASCII code and should only be made with full recognition of the contents of Section A5 of the Appendix on graphic substitution.

Table 1
OCR Character Substitutions

Key Position	Standard Character (ASCII)	Substitute Character (ASCSOCR)
E01	!	¥
E02	@	£
E03	#	ñ
E06	^	¢
D11	]	CE*
D11	[	GE*

*It is anticipated that these characters will be included in the revision of American National Standard X3.17-1966.

3.3.5 A keyboard containing the center 64 graphic characters (column 2-5) of ASCII is obtained by removing keys E13 and C12, and the uppercase portion of key D12.

4. Revision of American National Standards Referred to in This Document

When any of the following American National Standards referred to in this document is superseded by a revision approved by the American National Standards Institute, the revision shall apply:

American National Standard Code for Information Interchange, X3.4-1968

American National Standard Character Set for Optical Character Recognition, X3.17-1966

American National Standard Typewriter Keyboards, X4.7-1966

Appendix

(This Appendix is not a part of American National Standard Alphanumeric Keyboard Arrangements Accommodating the Character Sets of American National Standard Code for Information Interchange and American National Standard Character Set for Optical Character Recognition, X4.14-1971, but is included for information purposes only.)

Considerations for Keyboard Arrangements

A1. Introduction

This Appendix contains the criteria and other design considerations that were used in developing this standard.

A2. Criteria

The following criteria were adopted (not listed in order of priority) to reflect the needed transitions from historically developed divergent keyboard designs to a standard that would be compatible with the ASCII and ASCSOCR character sets. Not all criteria have been satisfied by this standard.

A2.1 The standard should exclude physical characteristics associated with keyboards, other than the nominal relative location of the keys.

A2.2 The keyboard arrangement should accommodate all 128 (graphic and control) ASCII characters and should take into account the needs of ASCSOCR characters.

A2.3 The location of a specific character should remain unchanged in keyboard arrangements accommodating fewer than 128 ASCII characters.

A2.4 The keyboard arrangement should:

(1) Facilitate simplicity of design.
(2) Provide ease of operation.
(3) Minimize operator training and retraining.
(4) Be acceptable for international standardization.
(5) Have maximum resemblance to present office electric typewriter, data communications and data processing keyboard arrangements.
(6) Minimize the total number of graphic keys.
(7) Minimize the total number of function keys.

A3. Discussion of Criteria

A3.1 In order to provide an all-inclusive standard, all 128 ASCII characters have been assigned. The 95 ASCII graphics (*space* included) have been assigned in a 48-key arrangement (Fig. 1). The 32 control characters, plus delete, have been assigned general areas. Provisions have been made to accommodate the 6 OCR characters (see note to Table 1) not contained in ASCII.

A3.2 In order to provide an all-inclusive keyboard arrangement compatible with American National Standard Typewriter Keyboards, X4.7-1966, it was necessary to substitute the ASCII graphics circumflex, right bracket and left bracket for the ¢, 1/4, and 1/2 symbols of American National Standard X4.7-1966. This substitution was not considered detrimental to good keyboard practice.

A3.3 Fig. 1 of this standard is the keyboard arrangement for information interchange which has been submitted to the International Organization for Standardization (ISO).

A3.4 Consideration was given to incorporating the last nine characters (Ø through ¥) for international consideration contained in Appendix B of American National Standard Character Set for Optical Character Recognition, X3.17-1966, in the keyboard proposal. However, since they are not a part of the ASCSOCR standard, and data concerning frequency of usage of these characters were not available, it was decided that it would be impractical to include them in any proposed American National Standard.

A4. Specific Design Considerations for Arrangement of Keyboards

A4.1 It was apparent that a standard positional notation was needed for easy reference to indicate key positions on which graphics were to be placed. The notational system used is included as a part of this standard.

A4.2 A review was made of designation of keys in American standards and other national and international standards for keyboard arrangements. No general agreement for key designations could be found among standard documents, nor could there be found any agreement in communities concerned with keyboards, such as the industrial, educational, and governmental communities.

With these facts in mind, this key designation system has been developed to allow the expansion of the keyboard area to any size, without bringing about inconsistencies in key designations. This, in turn, will allow efficient communication, either by means of written documents, or by means of oral instructions among those who develop keyboard arrangements, those who are required to consider the specifications of devices with keyboards and have a need to minimize the ambiguity as to the location of given keys, and those who are to learn the operation of devices with keyboards.

A4.3 After a thorough analysis of all (national and international) keyboard devices, it was decided that a four-row arrangement was the most practical approach for implementing the character sets.

A4.4 The "QWERTY" or "Sholes" keyboard arrangement of the alphabet that has evolved over the years was used as a basis for the standard. In addition to the many typewriters in use, this keyboard arrangement has also been used by many teleprinters and similar alphabet keyboard devices. As a result, much time and money has been invested in training and texts for operating keyboards using this arrangement.

A4.5 The arrangement of the ASCII code table (see Fig. A1) intentionally makes practical the pairing of corresponding characters of columns 2 and 3, columns 4 and 6, and columns 5 and 7, so that in a keyboard giving a binary coded output, the inversion of a single bit (b5 or b6, as appropriate) can affect the "shift" for any key. The standard arrangement in Fig. 1 follows such a pairing. When a shift key is operated, the appropriate bit is changed from "1" to "0" except for the keys bearing the following characters:

} { ¦ ~ = ` < > ?

] [\ ^ - @ , . /

(key positions C12, D12, E13, E12, E11, D11, B08, B09, and B10), where inversion is of the opposite sense. These nine were so arranged, owing to the relatively higher usage of:

] [\ ^ - @ , . /

SP (space) was not paired with *zero* due to the severe conflict this would have produced with present practice. Underline is normally unpaired. However, DEL (delete), its logical mate, is included in this arrangement as provided in 3.2.1 (Fig. A2 summarizes the relationships for the arrangement in Fig. 1.)

A4.6 The standard arrangement in Fig. 2 follows the arrangement specified in American National Standard X4.7-1966, plus the addition of the ASCII graphics not covered by that standard. Fig. A3 summarizes the relationships for the arrangement in Fig. 2.

A5. Graphic Substitution

Within any particular application, equipment configuration, or closed system, it may be necessary to substitute graphics. For example, some applications and systems may require special graphic symbols. Design efforts for the standard keyboard arrangement included consideration of these types of adaptations.

A5.1 This standard specifies the assignment of the graphic characters of American National Standard Code for Information Interchange, X3.4-1968, and American National Standard Character Set for Optical Character Recognition, X3.17-1966. Any substitution, except when using the ISO 7-bit code (ISO Recommendation R 646-1967, *6 and 7 Bit Coded Character Sets for Information Processing Interchange*[1] [Geneva: International Organization for Standardization, December 1967, 1st edition]) in an international environment, will result in a keyboard arrangement which does not conform to this standard.

A5.2 It is recommended that when a graphic is substituted in the standard keyboard arrangement, the displaced graphic should not be reassigned elsewhere on the standard keyboard. Such a substitute graphic, once assigned, should not be subsequently reassigned elsewhere.

[1] When this ISO Recommendation is superseded by a revision, the revision shall apply. ISO R 646-1967 is available from the American National Standards Institute, 1430 Broadway, New York, N.Y. 10018.

Fig. A1.
Standard Code*

Bits b_4 b_3 b_2 b_1	Row	Col 0 (b_7 b_6 b_5 = 0 0 0)	Col 1 (0 0 1)	Col 2 (0 1 0)	Col 3 (0 1 1)	Col 4 (1 0 0)	Col 5 (1 0 1)	Col 6 (1 1 0)	Col 7 (1 1 1)
0 0 0 0	0	NUL	DLE	SP	0	@	P	`	p
0 0 0 1	1	SOH	DC1	!	1	A	Q	a	q
0 0 1 0	2	STX	DC2	"	2	B	R	b	r
0 0 1 1	3	ETX	DC3	#	3	C	S	c	s
0 1 0 0	4	EOT	DC4	$	4	D	T	d	t
0 1 0 1	5	ENQ	NAK	%	5	E	U	e	u
0 1 1 0	6	ACK	SYN	&	6	F	V	f	v
0 1 1 1	7	BEL	ETB	'	7	G	W	g	w
1 0 0 0	8	BS	CAN	(	8	H	X	h	x
1 0 0 1	9	HT	EM	)	9	I	Y	i	y
1 0 1 0	10	LF	SUB	*	:	J	Z	j	z
1 0 1 1	11	VT	ESC	+	;	K	[	k	{
1 1 0 0	12	FF	FS	,	<	L	\	l	\|
1 1 0 1	13	CR	GS	-	=	M	]	m	}
1 1 1 0	14	SO	RS	.	>	N	^	n	~
1 1 1 1	15	SI	US	/	?	O	_	o	DEL

*This figure is reprinted from American National Standard X3.4-1968.

Fig. A2.
Character Pairing Relationships on Keyboard
for Logical Bit Pairing for Alphanumerical Arrangements
(Refer to Fig. 1)

UNSHIFTED BIT CONDITION B_7 B_6 B_5	UNSHIFTED GRAPHIC REPRES.	KEY POSITION NUMBER	SHIFT BIT CONDITION B_7 B_6 B_5	SHIFT GRAPHIC REPRES.	CONTROL BIT CONDITION B_7 B_6 B_5	CONTROL CONTROL REPRES.
1 0 0	@	D11	1 1 0	\	0 0 0	NUL
1 1 0	a	C01	1 0 0	A	0 0 0	SOH
1 1 0	b	B05	1 0 0	B	0 0 0	STX
1 1 0	c	B03	1 0 0	C	0 0 0	ETX
1 1 0	d	C03	1 0 0	D	0 0 0	EOT
1 1 0	e	D03	1 0 0	E	0 0 0	ENQ
1 1 0	f	C04	1 0 0	F	0 0 0	ACK
1 1 0	g	C05	1 0 0	G	0 0 0	BEL
1 1 0	h	C06	1 0 0	H	0 0 0	BS
1 1 0	i	D08	1 0 0	I	0 0 0	HT
1 1 0	j	C07	1 0 0	J	0 0 0	LF
1 1 0	k	C08	1 0 0	K	0 0 0	VT
1 1 0	l	C09	1 0 0	L	0 0 0	FF
1 1 0	m	B07	1 0 0	M	0 0 0	CR
1 1 0	n	B06	1 0 0	N	0 0 0	SO
1 1 0	o	D09	1 0 0	O	0 0 0	SI
1 1 1	p	D10	1 0 1	P	0 0 1	DLE
1 1 1	q	D01	1 0 1	Q	0 0 1	DC1
1 1 1	r	D04	1 0 1	R	0 0 1	DC2
1 1 1	s	C02	1 0 1	S	0 0 1	DC3
1 1 1	t	D05	1 0 1	T	0 0 1	DC4
1 1 1	u	D07	1 0 1	U	0 0 1	NAK
1 1 1	v	B04	1 0 1	V	0 0 1	SYN
1 1 1	w	D02	1 0 1	W	0 0 1	ETB
1 1 1	x	B02	1 0 1	X	0 0 1	CAN
1 1 1	y	D06	1 0 1	Y	0 0 1	EM
1 1 1	z	B01	1 0 1	Z ①	0 0 1	SUB
1 0 1	—	D13	1 0 1	— ①	0 0 1	US
0 1 1	0(ZERO	E10		NOT PAIRED		NP
0 1 1	1	E01	0 1 0	!		NP
0 1 1	2	E02	0 1 0	"		NP
0 1 1	3	E03	0 1 0	#		NP
0 1 1	4	E04	0 1 0	$		NP
0 1 1	5	E05	0 1 0	%		NP
0 1 1	6	E06	0 1 0	&		NP
0 1 1	7	E07	0 1 0	'		NP
0 1 1	8	E08	0 1 0	(		NP
0 1 1	9	E09	0 1 0	)		NP
0 1 1	:	C11	0 1 0	*		NP
0 1 1	;	C10	0 1 0	+		NP
0 1 0	,	B08	0 1 1	<		NP
0 1 0	-	E11	0 1 1	=		NP
0 1 0	.	B09	0 1 1	>		NP
0 1 0	/	B10	0 1 1	?		NP
1 0 1	^	E12	1 1 1	~	0 0 1	RS
1 0 1	\	E13	1 1 1	\|	0 0 1	FS
1 0 1	[	D12	1 1 1	{	0 0 1	ESC
1 0 1	]	C12	1 1 1	}	0 0 1	GS

NOTES:

NP = Not Paired

① If Option Of 2.2.1 Is Chosen Shifted Mode Is: B_7 B_5 B_5(Delete) 1 1 1

Fig. A3.
Character Pairing Relationships on Keyboard for Typewriter Pairing Alphanumeric Arrangements (Refer to Fig. 2)

KEY POSITION NUMBER	UNSHIFTED								SHIFT							
	BIT CONDITION							GRAPHIC REPRES.	BIT CONDITION							GRAPHIC REPRES.
	B_1	B_2	B_3	B_4	B_5	B_6	B_7		B_1	B_2	B_3	B_4	B_5	B_6	B_7	
C01	1	0	0	0	0	1	1	a	1	0	0	0	0	0	1	A
B05	0	1	0	0	0	1	1	b	0	1	0	0	0	0	1	B
B03	1	1	0	0	0	1	1	c	1	1	0	0	0	0	1	C
C03	0	0	1	0	0	1	1	d	0	0	1	0	0	0	1	D
D03	1	0	1	0	0	1	1	e	1	0	1	0	0	0	1	E
C04	0	1	1	0	0	1	1	f	0	1	1	0	0	0	1	F
C05	1	1	1	0	0	1	1	g	1	1	1	0	0	0	1	G
C06	0	0	0	1	0	1	1	h	0	0	0	1	0	0	1	H
D08	1	0	0	1	0	1	1	i	1	0	0	1	0	0	1	I
C07	0	1	0	1	0	1	1	j	0	1	0	1	0	0	1	J
C08	1	1	0	1	0	1	1	k	1	1	0	1	0	0	1	K
C09	0	0	1	1	0	1	1	l	0	0	1	1	0	0	1	L
B07	1	0	1	1	0	1	1	m	1	0	1	1	0	0	1	M
B06	0	1	1	1	0	1	1	n	0	1	1	1	0	0	1	N
D09	1	1	1	1	0	1	1	o	1	1	1	1	0	0	1	O
D10	0	0	0	0	1	1	1	p	0	0	0	0	1	0	1	P
D01	1	0	0	0	1	1	1	q	1	0	0	0	1	0	1	Q
D04	0	1	0	0	1	1	1	r	0	1	0	0	1	0	1	R
C02	1	1	0	0	1	1	1	s	1	1	0	0	1	0	1	S
D05	0	0	1	0	1	1	1	t	0	0	1	0	1	0	1	T
D07	1	0	1	0	1	1	1	u	1	0	1	0	1	0	1	U
B04	0	1	1	0	1	1	1	v	0	1	1	0	1	0	1	V
D02	1	1	1	0	1	1	1	w	1	1	1	0	1	0	1	W
B02	0	0	0	1	1	1	1	x	0	0	0	1	1	0	1	X
D06	1	0	0	1	1	1	1	y	1	0	0	1	1	0	1	Y
B01	0	1	0	1	1	1	1	z	0	1	0	1	1	0	1	Z
E10	0	0	0	0	1	1	0	0	1	0	0	1	0	1	0	)
E01	1	0	0	0	1	1	0	1	1	0	0	0	0	1	0	!
E02	0	1	0	0	1	1	0	2	0	0	0	0	0	0	1	@
E03	1	1	0	0	1	1	0	3	1	1	0	0	0	1	0	#
E04	0	0	1	0	1	1	0	4	0	0	0	0	0	1	0	$
E05	1	0	1	0	1	1	0	5	1	0	1	0	0	1	0	%
E06	0	1	1	0	1	1	0	6	0	1	1	1	1	0	1	^
E07	1	1	1	0	1	1	0	7	0	1	1	0	0	1	0	&
E08	0	0	0	1	1	1	0	8	0	1	0	1	0	1	0	*
E09	1	0	0	1	1	1	0	9	0	0	0	1	0	1	0	(
E11	1	0	1	1	0	1	0	-	1	1	1	1	1	0	1	_
E12	1	0	1	1	1	1	0	=	1	1	0	1	0	1	0	+
E13	0	0	0	0	0	1	1	\	0	1	1	1	1	1	1	~
D11	1	1	0	1	1	0	1	[	1	0	1	1	1	0	1	{
D12	0	0	1	1	1	0	1	]	0	0	1	1	1	1	1	}
C10	1	1	0	1	1	1	0	;	0	1	0	1	1	1	0	:
C11	1	1	1	0	0	1	0	'	0	1	0	0	0	1	0	"
C12	1	1	0	1	1	1	1	`	1	0	1	1	1	1	1	¬
B08	0	0	1	1	0	1	0	,	0	0	1	1	1	1	0	<
B09	0	1	1	1	0	1	0	.	0	1	1	1	1	1	0	>
B10	1	1	1	1	0	1	0	/	1	1	1	1	1	1	0	?

ANSI®
X4.22-1983

American National Standard for Office Machines and Supplies — Alphanumeric Machines — Alternate Keyboard Arrangement

Secretariat
Computer and Business Manufacturers Association

Approved November 19, 1982
American National Standards Institute, Inc

American National Standard

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Foreword

(This Foreword is not a part of American National Standard X4.22-1983.)

The alternate keyboard is the result of research done by August Dvorak and William Dealey in the 1930s. This research was based on the Time-and-Motion Studies of Frank and Lilian Gilbreth.

The advantages of the alternate keyboard are:

(1) The right hand does more work than the left (56% and 44%, respectively)
(2) The work assigned to the different fingers is proportionate to their strength and skill
(3) Seventy percent of keyboarding is done on the home row, 22% on the third row, and 8% on the lower row
(4) Finger motions from row to row have been reduced 90%
(5) Three thousand words (35% of all words used in ordinary copy) are typed exclusively on the home row
(6) Only 61 different, infrequently used, monosyllabic words are keyed exclusively by one hand, whereas over 3800 different, infrequently used, monsyllabic words are typed by one hand on the "QWERTY" (regular) keyboard

These advantages help to reduce the natural fatigue that comes from typing and to increase the typist's typing speed and work output.

ANSI X4.22-1983 offers an alternative to the keyboard presented in American National Standard for Office Machines and Supplies – Alphanumeric Machines – Keyboard Arrangement, ANSI X4.23-1982. Both these standards were developed due to the growing need in the word processing environment for additional graphic characters on the keyboard and with the expansion of foreign keyboards to 48 keys. Technical Committee X3V1 (Office Systems) worked diligently to develop a 48-key (96-character) keyboard for the United States. It was decided early in the development process that the American National Standard for Typewriter Keyboard Arrangement, ANSI X4.7-1973 was to be adopted as the base for this expanded keyboard. The prime motivation for the changes to this standard came from the results of a survey distributed to a cross section of the following market sectors:

(1) Government
(2) Manufacturers
(3) Engineering and technical industries
(4) Business
(5) Libraries
(6) Educational institutions
(7) Metric committee

The questionnaire contained a number of questions regarding a 96-character arrangement. Two specific questions related to (1) the new graphics that would be desired on the keyboard and (2) those graphics presently on the keyboard that would be expendable to gain more useful graphics.

The purpose of this standard is to provide the greatest benefit to the user of alphanumeric machines in the areas of operating, purchasing, and interchanging machines and training operators. Users will be able to use this standard to determine the keyboard arrangement that will best meet their application.

This standard also covers the two shift keys and the space bar of the keyboard. There are no specifications for physical characteristics and dimensions of the keys and keyboard. The standard relates to the keyboard arrangement only.

Ad Hoc Committee X4/DSK, under the direction of the American National Standards Committee on Office Machines and Supplies, X4, was responsible for the development of this standard. In January 1981, Committee X4 merged with the American National Standards Committee on Information Processing Systems, X3. At that time, Ad Hoc Committee X4/DSK was redesignated Technical Committee X3V1 (Office Systems).

Suggestions for improvement of this standard will be welcome. They should be sent to the Computer and Business Equipment Manufacturers Association, 311 First Street, NW, Suite 500, Washington, D.C. 20001.

This standard was processed and approved for submittal to ANSI by American National Standards Committee on Information Processing Systems, X3. Committee approval of the standard does not imply that all committee members voted for its approval. At the time it approved this standard, the X3 Committee had the following members:

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J. A. N. Lee, Vice-Chairman
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Technical Committee X3V1 (originally Ad Hoc Committee X4/DSK) on Office Systems, which developed this standard, had the following members:

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Table A1 Inboard Control Assignments for Coded Keyboards 11

American National Standard for Office Machines and Supplies – Alphanumeric Machines – Alternate Keyboard Arrangement

1. Scope and Purpose

1.1 Scope. This standard provides a performance-oriented keyboard arrangement that is an alternative to the keyboard presented in American National Standard for Office Machines and Supplies – Alphanumeric Machines – Keyboard Arrangement, ANSI X4.23-1982, and that is equally applicable to all alphanumeric keyboard devices.

This standard describes the arrangement of the 44 basic printing keys on the alternate keyboard and the characters, uppercase and lowercase, that appear on the keys. The keyboard also provides for a maximum of four additional keys as well as recommended graphic assignments for these keys and some recommended graphic substitutions. These recommended graphic character assignments include those required by the established coded character sets for information interchange as defined in the American National Standard Code for Information Interchange, ANSI X3.4-1977, the American National Standard Character Set for Optical Character Recognition (OCR-A), ANSI X3.17-1981, and the American National Standard Character Set for Optical Character Recognition (OCR-B), ANSI X3.49-1975.

This standard also covers the two shift keys and the space bar. However, this standard does not specify the physical characteristics and dimensions of the keys and keyboard. It relates to the keyboard arrangement only.

1.2 Purpose. The purpose of this standard is to provide potential for increased efficiency, with the greatest benefit to the user in the areas of operating, purchasing, and interchanging machines and training operators.

2. Related American National Standards

This standard is intended to be used in conjunction with the following American National Standards (see Section 6):

American National Standard Code for Information Interchange, ANSI X3.4-1977

American National Standard Character Set for Optical Character Recognition (OCR-A), ANSI X3.17-1981

American National Standard Character Set for Optical Character Recognition (OCR-B), ANSI X3.49-1975

American National Standard for Office Machines and Supplies – Alphanumeric Machines – Keyboard Arrangement, ANSI X4.23-1982

3. Definitions

alphabetic order. The order in which the letters of the alphabet appear on the keyboard.

alphanumeric order. The order in which the letters of the alphabet and the Arabic numbers appear on the keyboard.

case. A group of characters similarly positioned with respect to the shift.

functional key. The key on the machine that, when activated, produces a machine action other than a printing impression, such as space, shift, backspace, etc.

graphic character. A character intended to be written, printed, or otherwise displayed in a form that can be read. It should be noted that *space* is considered to be a graphic character in codes for information interchange.

key (key top, key button). A finger-contact member, the activation of which results in a machine response.

keyboard. The area of a machine on which the printing and functional keys are arrayed.

keyboard arrangement. The position of the keys relative to one another and the arrangement of characters on them.

lowercase (l/c). A group of characters, usually containing the small alphabet, numerals, and certain symbols, that are in printing position with the shift key in its customary position (not depressed).

numeric order. The order in which the Arabic numbers appear on the keyboard.

primary use graphic character. A graphic that has been selected as a prime candidate for the keyboard on the basis of its usage as determined through the results of a survey of market sectors utilizing typewriter-like keyboard products.

printing key. A key on the machine, the activation of which results in a printing impression.

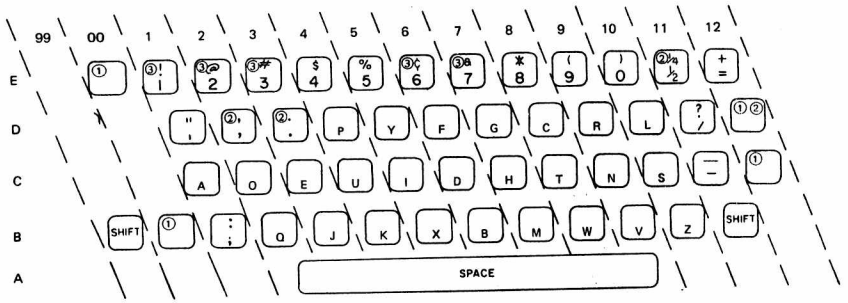
shift. The facility to change from one case to another.

symbol. Any of the punctuation marks and signs used instead of a word or words to represent an operation, relationship, spoken sound, etc.

uppercase (u/c). A group of characters, usually containing the capital alphabet and certain symbols, that are brought into printing position by depressing the shift key.

4. Alternate Keyboard Arrangement

4.1 Fig. 1 shows the alternate arrangement of the keys and the characters assigned to them (including the two shift keys and the space bar). The four new keys have intentionally been left blank to allow for the selection and placement of graphics that would be most appropriate for the users in a major keyboard application area. However, recommendations for assigning some primary use unassigned graphics to these keys, as well as recommendations for graphic replacements to accommodate other primary use unassigned graphics, are included in the notes of Fig. 1.



① These positions are reserved for primary use unassigned graphic characters. The following primary use unassigned graphic characters and their allocation are recommended for these blank keys.

Key Position	*Graphic*
E00 u/c	° (Degree)
E00 l/c	± (Plus/minus)
D12 u/c	[(Left bracket)
D12 l/c	] (Right bracket)
C12 u/c	³ (Superscript 3)
C12 l/c	² (Superscript 2)
B00 u/c	¶ (Paragraph)
B00 l/c	§ (Section)

② These assigned graphic characters should be allocated as shown. If a specific application allows for graphic replacement to accommodate other primary use unassigned graphic characters, the following is recommended.

Key Position	*Assigned*	*Replacement*
D02 u/c	, (Comma)	< (Less than)
D03 u/c	. (Period)	> (Greater than)
E11 u/c	¼ (One-quarter)	[(Left bracket)
E11 l/c	½ (One-half)	] (Right bracket)

The following graphic character assignment is recommended for key position D12 replacing the square brackets recommended in Note 1 above.

Key Position	*Graphic*
D12 u/c	μ (Mu)
D12 l/c	· (Product dot)

③ These assigned graphic characters (@, ¢, #, ! and &) should be allocated as shown. If they are not required for a specific application, they may be replaced by other primary use unassigned graphic characters.

④ Physical characteristics and locations (that is, size, shape, skew, etc) of the space bar or of the keys are not to be inferred.

Fig. 1
Alternate Keyboard Arrangement

4.2 A keyboard containing between 44 and 48 keys is in conformance with this standard, providing the location of graphics, when used, are as specified in this standard.

4.3 In Fig. 1, the keys labeled with the letters of the alphabet are intended to produce lowercase letters in the unshifted (lowercase) mode and uppercase letters in the shifted (uppercase) mode. The other keys are intended to produce the lower character as shown on the key in the unshifted mode, and the upper character as shown on the key in the shifted mode.

4.4 No locations are defined herein for functional keys that may be required on the keyboard device, other than the two shift keys.

5. Keyboards for Information Interchange

For keyboards used for information interchange, the graphic character assignments and substitutions in Table 1 should be used with the keyboard arrangement of Fig. 1, to provide the character set desired for the intended application. The coding for these graphic character sets is not specified by Table 1. (The coding will become a part of a standard being developed by Subcommittee X3L2 on Coded Character Sets.)

Notes 2 and 3 of Fig. 1 can also be applied to keyboards for information interchange, but may be restricted to specific applications in order to maintain keyboard code compatibility.

6. Revision of American National Standards Referred to in This Document

When the American National Standards referred to in this document are superseded by a revision approved by the American National Standards Institute, Inc, the revision shall apply.

Table 1
Character Assignments for Keyboards for Information Interchange

Key Position	Word Processing	American Standard Code for Information Interchange (ASCII)	Optical Character Recognition (Style A) (OCR-A)*	Optical Character Recognition (Style B) (OCR-B)*
E00 u/c	°	~	⑆	NA
E00 l/c	±	`	⑇	NA
D12 u/c	[	[	[	[
D12 l/c	]	]	]	]
C12 u/c	³	{	{	{
C12 l/c	²	}	}	}
B00 u/c	¶	>	>	>
B00 l/c	§	<	<	<
E11 u/c	¼	\	\	\
E11 l/c	½	\|	\|	\|
E06 u/c	¢	^	^	^
C11 u/c	_	_	⑄	_
D02 u/c	´	´	CE	CE
D03 u/c	.	.	GE	GE

*Extended repertoire of OCR graphics should be allocated as presented in the OCR standards (ANSI X3.17-1981 and ANSI X3.49-1975).

Appendix

(This Appendix is not a part of American National Standard X4.22-1983, but is included for information purposes only.)

Criteria for the Alternate Keyboard Arrangement

A1. Introduction

This appendix contains the criteria and other considerations that were used in developing the alternate keyboard arrangement. Also included is the criteria for addition of keys and characters to the keyboard arrangement.

A2. Criteria

A2.1 The alternate keyboard arrangement should be based on the character set and uppercase/lowercase character pairings of the standard keyboard arrangement as described in ANSI X4.23-1982.

A2.2 The additional characters to be added, in accordance with existing international standards, should be lodated in the "touchtype" area.

A2.3 The additional characters to be added should be those that have the greatest utility across the wide variety of applications in which typewriter-like keyboards are used in the business environment.

A2.4 Consideration should be given for potential graphic characters presently assigned that could possibly be replaced by other primary use unassigned graphic characters.

A3. Discussion of Criteria for the Alternate Keyboard

A3.1 The placement of the four additional keys (E00, B00, C12, and D12) was based upon Typewriters – Layout of Printing and Function Keys, ISO 1091-1977, Keyboards for Countries Whose Languages Have Alphabetic Extenders – Guidelines for Harmonization, ISO 3243-1975, and ANSI X4.23-1982. The positioning of the keys was also supported by Human Factors Study for Keys Positioning on a 48-Key Keyboard, ISO/TC95/SC14 (N20b). The 48-key arrangement adopted is also used internationally. Furthermore, a vast majority of the survey respondents indicated that they anticipated little difficulty in adjusting to the proposed keyboard changes.

A3.2 The committee, as a result of the responses to a proposed 48-key keyboard with 96 assigned graphic characters, decided to leave the four new keys blank to provide a general keyboard that would be capable of satisfying all levels of equipment and all application areas (i.e., text communications, technical, metric, legal, etc). As part of this decision, the graphics assignments made to the proposed 48-key keyboard are made a part of this standard only as recommendations.

A3.3 The graphic characters recommended in Note 1 of Fig. 1 for placement on the four unassigned keys are those which were most requested by users surveyed. The positioning of these graphics was determined primarily by their positions on keyboards already in the marketplace. The most used graphics were placed in the lowercase position. The left square bracket was placed in uppercase position since it will normally be coupled with an uppercase graphic character in the leading word of the sentence being bracketed.

A3.4 The survey results indicated that the following assigned graphic characters could be replaced by more preferred unassigned graphics:

Character	*Character Name*
,	Comma (u/c)
.	Period (u/c)
¼	One-quarter
½	One-half
@	At
¢	Cent
#	Number
!	Exclamation
&	Ampersand

The graphic characters are placed in the order of preference for substitution based on the number of survey responses selecting each character for substitution.

A3.5 The graphic characters recommended in Note 2 of Fig. 1 were selected from the list of graphic characters most requested by users surveyed. These graphic characters are recommended for replacement of the first four graphic characters listed in A3.4. An additional recommendation was made in Note 2 to move square brackets in a more prominent position by assigning the mu and product dot to the outboard key D12.

A3.6 Requests for more substitution possibilities (e.g., metric, etc) led to the addition of Note 3 which identifies those additional characters cited in A3.4 that, if not required for a specific application, may be replaced by other primary use unassigned graphic characters.

A3.7 In order to provide an all-inclusive keyboard standard, recommended graphic character assignments were made to accommodate the character sets of ASCII (ANSI X3.4-1977), OCR-A (ANSI X3.17-1981) and OCR-B (ANSI X3.49-1975). This was accomplished by replacing those graphics not contained in the specific character set. The positioning of these graphics was determined by their position on keyboards already in the marketplace, as well as the criteria of maintaining maximum resemblance to the word processing (correspondence) keyboard arrangement and other criteria used in the development of this standard. These substitutions are consistent with good keyboard practice.

A3.8 The recommended character assignments and substitutions set forth by TC X3V1 in A3.1 to A3.8 were adopted by Ad Hoc Committee X4DSK and used in developing the alternate keyboard arrangement as found in the notes of Fig. 1.

A3.9 Ad Hoc Committee X4DSK reviewed several alternative alphabetic character arrangements, all based on the principles of time and motion study. It was decided that the alternative alphabetic arrangement proposed by Dr A. Dvorak and his associates, based on extensive research as to the relative frequency of use of the various letters and letter sequences used in forming words, had merits sufficient to warrant its adoption.

A3.10 With this keyboard arrangement, keyboard entry is simplified and results in a more evenly balanced workload between the left hand and the right hand, a more even distribution of the workload based on strength of the fingers, the concentration of a high percentage of typing on the home row keys, and the reduction of finger hurdling. This results in a reduction of operator fatigue, thereby producing increased efficiency.

A3.11 Certain decisions were necessary regarding the placement of the graphic character pairings "–', :–; , and ?–/. It was decided (see Fig. 1) that the :–; key be placed in position B1 because of its low frequency of use. In comparison, the "–' key, with its higher incidence of use, was assigned to the more accessible position on Row D. The left-side position of the "–' is confirmed by the use of the apostrophe on contractions and possessives. Since the apostrophe always precedes a consonant in the English language, alternate hand stroking is facilitated. Neither a left-side nor a right-side position for the ? is ideal and either position could result in awkward stroking, but the incidence of use is quite low in many applications. Therefore, the ? was assigned to position D12. The lower case position of the / is confirmed as it is mainly used with numerals and constructed fractions.

A4. Coded Keyboards – ASCII Control Characters

A4.1 This section recommends the key assignments for the 32 control characters and DEL of ANSI X3.4-1977 when they are required. The symbols for the control characters are given here; see ANSI X3.4-1977 for the coding of these control characters. These controls may be used with any of the graphic character arrangements in this standard.

A4.2 Inboard and outboard locations are provided for the control characters of the character set of ANSI X3.4-1977. The inboard control locations on coded keyboards should be on the alphanumeric keys paired with the ASCII assigned characters shown in Table A1. The function of the CONTROL FUNCTION key(s) is to set the keyboard in the control mode while it is operated (depressed). It will cause those keys having

Table A1
Inboard Control Assignments for Coded Keyboards

Code	Key	Code	Key
NUL	2	DLE	P
SOH	A	DC1	Q
STX	B	DC2	R
ETX	C	DC3	S
EOT	D	DC4	T
ENQ	E	NAK	U
ACK	F	SYN	V
BEL	G	ETB	W
BS	H	CAN	X
HT	I	EM	Y
LF	J	SUB	Z
VT	K	ESC	3
FF	L	FS	4
CR	M	GS	5
SO	N	RS	6
SI	O	US	7
		DEL	8

NOTE: The assignment of the seven control characters to keys 2 through 8 maximizes the compatibility with the original arrangement in ANSI X4.14-1971 (NUL was @ and RS was ^) and avoids the 0 (zero) which is easily confused with O (letter oh) and 1 (one) which is easily confused with l (letter el). (ANSI X4.14-1971 has been superseded by ANSI X4.23-1982.)

control character assignments to generate their respective control codes in accordance with ANSI X3.4-1977, regardless of the state of the SHIFT or SHIFT LOCK key. The areas designated for outboard controls are located to the left and to the right of the alphanumeric area. The outboard control area is undefined in the exact placement of keys, because it will vary with application. Depression of an outboard key with a single control character on it will generate its respective code, regardless of the state of the SHIFT or SHIFT LOCK key. Outboard keys may also have two control characters, one in unshifted mode and the other in shifted mode.

A4.3 This standard is not intended to regulate the assignment of a control both to a key prescribed herein and also to another key in a position not assigned in the standard arrangements.

ANSI®
X4.23-1982

American National Standard for Office Machines and Supplies — Alphanumeric Machines — Keyboard Arrangement

Secretariat

Computer and Business Equipment Manufacturers Association

Approved August 11, 1982

American National Standards Institute, Inc

American National Standard

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Foreword

(This Foreword is not a part of American National Standard X4.23-1982.)

With the growing need in the word processing environment for additional graphic characters on the keyboard and with the foreign keyboards expanding to 48 keys, Technical Committee X3V1 (Office Systems) worked diligently to develop a 48-key (98-character) keyboard for the United States. It was decided early in the development process that the American National Standard for Typewriter Keyboard Arrangement, ANSI X4.7-1973 was to be adopted as the base for this expanded keyboard. The prime motivation for the changes to this standard came from the results of a survey distributed to a cross section of the following market sectors:

(1) Government
(2) Manufacturers
(3) Engineering and technical industries
(4) Business
(5) Libraries
(6) Educational institutions
(7) Metric committee

The questionnaire contained a number of questions regarding a 96-character arrangement. Two specific questions related to (1) the new graphics that would be desired on the keyboard and (2) those graphics presently on the keyboard that would be expendable to gain more useful graphics.

The purpose of this standard is to provide the greatest benefit to the user of alphanumeric machines in the areas of operating, purchasing, and interchanging machines and training operators. Users will be able to use this standard to determine the keyboard arrangement that will best meet their application.

This standard also covers the two shift keys and the space bar of the keyboard. There are no specifications for physical characteristics and dimensions of the keys and keyboard. The standard relates to the keyboard arrangement only.

This standard supersedes the American National Standard for Typewriter Keyboard Arrangement, ANSI X4.7-1973, and the American National Standard Alphanumeric Keyboard Arrangements Accommodating the Character Sets of ASCII and ASCSOCR, ANSI X4.14-1971.

Technical Committee X4A12 (Word Processing), under the direction of the American National Standards Committee for Office Machines and Supplies, X4, was responsible for the development of this standard. In January 1981, Committee X4 merged with the American National Standards Committee on Information Processing Systems, X3. At that time, Technical Committee X4A12 was redesignated Technical Committee X3V1 (Office Systems). During the course of development, TC X3V1 mailed the proposed standard to several hundred users, considered all responses, and did a follow-up survey of a number of users before finalizing this standard.

Suggestions for improvement of this standard will be welcome. They should be sent to the Computer and Business Equipment Manufacturers Association, 311 First Street, NW, Suite 500, Washington, D.C. 20001.

This standard was processed and approved for submittal to ANSI by American National Standards Committee on Information Processing Systems, X3. Committee approval of the standard does not imply that all committee members voted for its approval. At the time it approved this standard, the X3 Committee had the following members:

John F. Auwaerter, Chairman
J. P. Ancona, Vice-Chairman
J. A. N. Lee, Vice-Chairman
Catherine A. Kachurik, Administrative Secretary

Organization Represented	*Name of Representative*
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	Chris Crawford (Alt)
American Express Company	R. S. Newman
	R. G. Wilson (Alt)
American Nuclear Society	Geraldine C. Main
	D. R. Vondy (Alt)
AMP Incorporated	Patrick E. Lannan
	C. Brill (Alt)
Association for Computing Machinery	J. A. N. Lee
	Pat Skelly (Alt)
Association of American Railroads	R. A. Petrash
Association of Computer Users	Hillel Segal
	Thomas Kurihara (Alt)
Burroughs Corporation	Ira R. Purchis
	Jerrold S. Foley (Alt)
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	A. G. W. Biddle (Alt)
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Digital Equipment Corporation	Patricia W. White
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General Services Administration	William C. Rinehuls
	Donald J. Page (Alt)
GUIDE International	Frank Kirshenbaum
	Leland Milligan (Alt)
Harris Corporation	Sam Mathan
	David Abmayr (Alt)
Hewlett-Packard	Donald C. Loughery
Honeywell Information Systems	Thomas J. McNamara
	Alan Teubner (Alt)
IBM Corporation	Mary Anne Gray
	William F. McClelland (Alt)
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IEEE Computer Society	Herbert Hecht
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National Communications System	Marshall L. Cain
	George W. White (Alt)
National Micrographics Association	John R. White
	Frank Malabaraba (Alt)
NCR Corporation	Thomas W. Kern
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OCR Users Association	Herbert E. Schantz
	G. W. Wetzel (Alt)
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	David Penniman (Alt)
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SHARE, Inc	Thomas B. Steel, Jr
	Daniel Schuster (Alt)
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	Harry Pontius (Alt)
U.S. Department of Justice	Daniel Schneider
	Joseph R. Lake, Jr (Alt)
Wang Laboratories, Inc.	Carl W. Schwarcz
	Marsha Hayek (Alt)
Xerox Corporation	John L. Wheeler
	Arthur R. Machell (Alt)

Technical Committee X3V1 (originally Technical Committee X4A12) on Office Systems, which developed this standard, had the following members:

L. M. Collins, Chairman
Frank Allen, Vice-Chairman and Secretary

G. A. Baugh
M. J. Bedford
J. Bruce
S. Cain
A. J. Carlo
M. Castro
R. Costa
A. R. Daniels
K. Dulabhan
A. W. Fiedler
S. M. Garland
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American National Standard for Office Machines and Supplies – Alphanumeric Machines – Keyboard Arrangement

1. Scope and Purpose

1.1 Scope. This standard describes the arrangement of the 44 basic printing keys on the keyboard and the characters, uppercase and lowercase, that appear on the keys. The keyboard also provides for a maximum of four additional keys as well as recommended graphic assignments for these keys and some recommended graphic substitutions. These recommended graphic character assignments include those required by the established coded character sets for information interchange as defined in the American National Standard Code for Information Interchange, ANSI X3.4-1977, the American National Standard Character Set for Optical Character Recognition (OCR-A), ANSI X3.17-1981, and the American National Standard Character Set for Optical Character Recognition (OCR-B), ANSI-X3.49-1975.

This standard also covers the two shift keys and the space bar. However, the standard does not specify the physical characteristics and dimensions of the keys and keyboard. It relates to the keyboard arrangement only.

This standard replaces the American National Standard for Typewriter Keyboard Arrangement, ANSI X4.7-1973 and the American National Standard Alphanumeric Keyboard Arrangements Accommodating the Character Sets of ASCII and ASCSOCR, ANSI X4.14-1971.

1.2 Purpose. The purpose of this standard is to provide the greatest benefit to the user in the areas of operating, purchasing, and interchanging machines and training operators.

2. Related American National Standards

This standard is intended to be used in conjunction with the following American National Standards (see Section 6):

American National Standard Code for Information Interchange, ANSI X3.4-1977

American National Standard Character Set for Optical Character Recognition (OCR-A), ANSI X3.17-1981

American National Standard Character Set for Optical Character Recognition (OCR-B), ANSI X3.49-1975

3. Definitions

alphabetic order. The order in which the letters of the alphabet appear on the keyboard.

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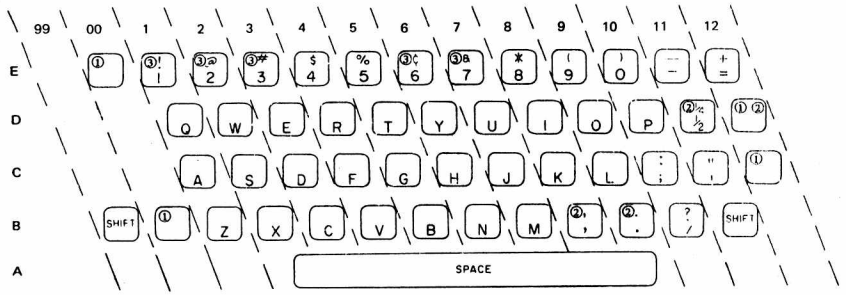
symbol. Any of the punctuation marks and signs used instead of a word or words to represent an operation, relationship, spoken sound, etc.

uppercase (u/c). A group of characters, usually containing the capital alphabet and certain symbols, that are brought into printing position by depressing the shift key.

4. Keyboard Arrangement

4.1 Fig. 1 shows the arrangement of the keys and the characters assigned to them (including the two shift keys and the space bar). The four new keys have intentionally been left blank to allow for the selection and placement of graphics that would be most appropriate for the users in a major keyboard application area. However, recommendations for assigning some primary use unassigned graphics to these keys, as well as recommendations for graphic replacements to accommodate other primary use unassigned graphics, are included in the notes of Fig. 1.

4.2 A keyboard containing between 44 and 48 keys is in conformance with this standard, providing the location of graphics, when used, are as specified in this standard.



① These positions are reserved for primary use unassigned graphic characters. The following primary use unassigned graphic characters and their allocation are recommended for these blank keys.

Key Position	*Graphic*
E00 u/c	° (Degree)
E00 l/c	± (Plus/minus)
D12 u/c	[(Left bracket)
D12 l/c	] (Right bracket)
C12 u/c	³ (Superscript 3)
C12 l/c	² (Superscript 2)
B00 u/c	¶ (Paragraph)
B00 l/c	§ (Section)

② These assigned graphic characters should be allocated as shown. If a specific application allows for graphic replacement to accommodate other primary use unassigned graphic characters, the following is recommended.

Key Position	*Assigned*	*Replacement*
B08 u/c	, (Comma)	< (Less than)
B09 u/c	. (Period)	> (Greater than)
D11 u/c	¼ (One-quarter)	[(Left bracket)
D11 l/c	½ (One-half)	] (Right bracket)

The following graphic character assignment is recommended for key position D12 replacing the square brackets recommended in Note 1 above.

Key Position	*Graphic*
D12 u/c	μ (Mu)
D12 l/c	• (Product dot)

③ These assigned graphic characters (@, ¢, #, ! and &) should be allocated as shown. If they are not required for a specific application, they may be replaced by other primary use unassigned graphic characters.

④ Physical characteristics and locations (that is, size, shape, skew, etc) of the space bar or of the keys are not to be inferred.

Fig. 1
Keyboard Arrangement

4.3 In Fig. 1, the keys labeled with the letters of the alphabet are intended to produce lowercase letters in the unshifted (lowercase) mode and uppercase letters in the shifted (uppercase) mode. The other keys are intended to produce the lower character as shown on the key in the unshifted mode, and the upper character as shown on the key in the shifted mode.

4.4 No locations are defined herein for functional keys that may be required on the keyboard device, other than the two shift keys.

5. Keyboards for Information Interchange

For keyboards used for information interchange, the graphic character assignments and substitutions in Table 1 should be used with the keyboard arrangement of Fig. 1, to provide the character set desired for the intended application. The coding for these graphic character sets is not specified by Table 1. (The coding will become a part of a standard being developed by Subcommittee X3L2 on Coded Character Sets.)

Notes 2 and 3 of Fig. 1 can also be applied to keyboards for information interchange, but may be restricted to specific applications in order to maintain keyboard code compatibility.

6. Revision of American National Standards Referred to in This Document

When the American National Standards referred to in this document are superseded by a revision approved by the American National Standards Institute, Inc, the revision shall apply.

Table 1
Character Assignments for Keyboards for Information Interchange

Key Position	Word Processing	American Standard Code for Information Interchange (ASCII)	Optical Character Recognition (Style A) (OCR-A)*	Optical Character Recognition (Style B) (OCR-B)*
E00 u/c	°	~	⑀	NA†
E00 l/c	±	`	⑁	NA†
D12 u/c	[	[	[	[
D12 l/c	]	]	]	]
C12 u/c	³	{	{	{ ‡
C12 l/c	²	}	}	} ‡
B00 u/c	¶	>	>	>
B00 l/c	§	<	<	<
D11 u/c	¼	\	\	\
D11 l/c	½	\|	\|	\|
E06 u/c	¢	^	^	^
E11 u/c	_	_	⑂	_
B08 u/c	'	'	CE†	CE†
B09 u/c	.	.	GE†	GE†

*Extended repertoire of OCR graphics should be allocated as presented in the OCR standards (ANSI X3.17-1981 and ANSI X3.49-1975).

†NA = not applicable; CE = character erase; GE = group erase.

‡Proposed.

Appendix

(This Appendix is not a part of American National Standard X4.23-1982, but is included for informational purposes only.)

Criteria for Addition of Keys and Characters to Keyboard Arrangement

A1. Introduction

This appendix contains the criteria and other considerations that were used in revising the American National Standard for Typewriter Keyboard Arrangement, ANSI X4.7-1973 and the inclusion of the appropriate data from the American National Standard for Alphanumeric Keyboard Arrangements Accommodating the Character Sets of ASCII and ASCSOCR, ANSI X4.14-1971, both of which are superseded by this document.

A2. Criteria

A2.1 The standard keyboard arrangement should have maximum resemblance to the typewriter keyboard arrangement contained in Fig. 1 of this standard.

A2.2 The additional keys to be added should be located in the "touchtype" area, and in accordance with Typewriters-Layout of Printing and Function Keys, ISO 1091-1977, and Keyboards for Countries Whose Languages Have Alphabetic Extenders-Guidelines for Harmonization, ISO 3243-1975.

A2.3 The additional characters to be added should be those that have the greatest utility across the wide variety of applications in which typewriter-like keyboards are used in the business environment.

A2.4 Consideration should be given for potential graphic characters presently assigned that could possibly be replaced by other primary use unassigned graphics characters.

A3. Discussion of Criteria

A3.1 The placement of the four additional keys (E00, B00, C12 and D12) was based upon ISO 1091-1977, ISO 3243-1975, and ANSI X4.14-1971. The positioning of the keys was also supported by Human Factors Study for Keys Positioning on a 48-Key Keyboard, ISO/TC95/SC14 (N20b). The 48-key arrangement adopted is also used internationally. Furthermore, a vast majority of the survey respondents indicated that they anticipated little difficulty in adjusting to the proposed keyboard changes.

A3.2 The committee, as a result of the responses to a proposed 48-key keyboard with 96 assigned graphic characters, decided to leave the four new keys blank to provide a general keyboard that would be capable of satisfying all levels of equipment and all application areas (i.e., text communications, technical, metric, legal, etc). As part of this decision, the graphics assignments made to the proposed 48-key keyboard are made a part of this standard only as recommendations.

A3.3 The graphic characters recommended in Note 1 of Fig. 1 for placement on the four unassigned keys are those which were most requested by users surveyed. The positioning of these graphics was determined primarily by their positions on keyboards already in the marketplace. The most used graphics were placed in the lowercase position. The left square bracket was placed in uppercase position since it will normally be coupled with an uppercase graphic character in the leading word of the sentence being bracketed.

A3.4 The survey results indicated that the following assigned graphic characters could be replaced by more preferred unassigned graphics:

Character	*Character Name*
,	Comma (u/c)
.	Period (u/c)
¼	One-quarter
½	One-half
@	At
¢	Cent
#	Number
!	Exclamation
&	Ampersand

The graphic characters are placed in the order of preference for substitution based on the number of survey responses selecting each character for substitution.

A3.5 The graphic characters recommended in Note 2 of Fig. 1 were selected from the list of graphic characters most requested by users surveyed. These graphic characters are recommended for replacement of the first four graphic characters listed in A3.4. An additional recommendation was made in Note 2 to move square brackets in a more prominent position by assigning the mu and product dot to the outboard key D12.

A3.6 Requests for more substitution possibilities (e.g., metric, etc) led to the addition of Note 3 which identifies those additional characters cited in A3.4 that, if not required for a specific application, may be replaced by other primary use unassigned graphic characters.

A3.7 In order to provide an all-inclusive keyboard standard, recommended graphic character assignments were made to accommodate the character sets of ASCII (ANSI X3.4-1977), OCR-A (ANSI X3.17-1981) and OCR-B (ANSI X3.49-1975). This was accomplished by replacing those graphics not contained in the specific character set. The positioning of these graphics was determined by their position on keyboards already in the marketplace, as well as the criteria of maintaining maximum resemblance to the word processing (correspondence) keyboard arrangement and other criteria used in the development of this standard. These substitutions are consistent with good keyboard practice.

A4. Coded Keyboards – ASCII Control Characters

A4.1 This section recommends the key assignments for the 32 control characters and DEL of ANSI X3.4-1977 when they are required. The symbols for the control characters are given here; see ANSI X3.4-1977 for the coding of these control characters. These controls may be used with any of the graphic character arrangements in this standard.

A4.2 Inboard and outboard locations are provided for the control characters of the character set of ANSI X3.4-1977. The inboard control locations on coded keyboards should be on the alphanumeric keys paired with the ASCII assigned characters shown in Table A1. The function of the CONTROL FUNCTION key(s) is to set the keyboard in the control mode while it is operated (depressed). It will cause those keys having control character assignments to generate their respective control codes in accordance with ANSI X3.4-1977, regardless of the state of the SHIFT or SHIFT LOCK key. The areas designated for outboard controls are located to the left and to the right of the alphanumeric area. The outboard control area is undefined in the exact placement of keys, because it will vary with application. Depression of an outboard key with a single control character on it will generate its respective code, regardless of the state of the SHIFT or SHIFT LOCK key. Outboard keys may also have two control characters, one in unshifted mode and the other in shifted mode.

A4.3 This standard is not intended to regulate the assignment of a control both to a key prescribed herein and also to another key in a position not assigned in the standard arrangements.

Table A1
Inboard Control Assignments for Coded Keyboards

Code	Key	Code	Key
NUL	2	DLE	P
SOH	A	DC1	Q
STX	B	DC2	R
ETX	C	DC3	S
EOT	D	DC4	T
ENQ	E	NAK	U
ACK	F	SYN	V
BEL	G	ETB	W
BS	H	CAN	X
HT	I	EM	Y
LF	J	SUB	Z
VT	K	ESC	3
FF	L	FS	4
CR	M	GS	5
SO	N	RS	6
SI	O	US	7
		DEL	8

NOTE: The assignment of the seven control characters to keys 2 through 8 maximizes the compatibility with the original arrangement in ANSI X4.14-1971 (NUL was @ and RS was ^) and avoids the 0 (zero) that is easily confused with O (letter oh) and 1 (one) that is easily confused with l (letter el).

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Revision and
redesignation of
ANSI X4.23-1982

American National Standard
for Office Machines and Supplies –

Alphanumeric Machines – Keyboard Arrangement

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Secretariat

Computer and Business Equipment Manufacturers Association

Approved January 27, 1988

American National Standards Institute, Inc

American National Standard

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Foreword

(This Foreword is not part of American National Standard X3.154-1988.)

In 1982 ANSI approved American National Standard for Office Machines and Supplies – Alphanumeric Machines – Keyboard Arrangement, ANSI X4.23-1982, as a result of a broad-based survey of government agencies, manufacturers, businesses, educational institutions, and other users. Since that time, the standard has become generally accepted as meeting most of the needs for alphanumeric data input. However, a few concerns have arisen that have caused Technical Committee X3V1 to write this revised standard.

One concern was editorial in nature. There were procurement situations in which interpretation of the standard was difficult, owing to the many complex relationships among text in the body of the standard, tabular material, and footnotes. Without removing the flexibility of the original standard, this new standard expresses the requirements explicitly so that the intended flexibility is unambiguous.

The second issue addressed was the human factors concerns expressed by users of the 48-key layout described in ANSI X4.23-1982. Many users found the location of the left shift key and the return key to be farther from the home position than they were accustomed to, with new graphic characters placed where the shift and return formerly were. The result was frequent mis-keying of input. The new standard allows a 47-key ASCII keyboard with both the left shift key and the return key in their original positions, nearer the home position.

In addition to these major improvements, the standard allows an improved arrangement of some of the graphic characters.

Because of the existing equipment base and manufacturing tooling, this standard does not disallow any of the options allowed in ANSI X4.23-1982. In the course of time, when the improvements of this present standard become widely known and available, it is anticipated that the older equipment will be replaced with equipment that takes advantage of these improvements.

This standard supersedes ANSI X4.23-1982.

Technical Committee X3V1 (Text: Office and Publishing Systems) under the direction of the Accredited Standards Committee on Information Processing Systems, X3, was responsible for the development of this standard.

Suggestions for improvement of this standard will be welcome. They should be sent to the Computer and Business Equipment Manufacturers Association, 311 First Street, NW, Suite 500, Washington, DC 20001.

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee on Information Processing Systems, X3. Committee approval of the standard does not imply that all committee members voted for its approval. At the time it approved this standard, the X3 Committee had the following members:

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American National Standard for Office Machines and Supplies –

Alphanumeric Machines – Keyboard Arrangement

1. Scope and Purpose

1.1 Scope. This standard describes the arrangement of the 48 basic printing keys on the keyboard and the uppercase and lowercase characters that appear on the keys. The character assignments are divided into five application areas, in recognition of the different graphic character requirements of each application.

The application areas that this standard addresses are:

(1) Input of American Standard Code for Information Interchange (ASCII) data characters, as specified in American National Standard for Information Systems – Coded Character Sets – 7-Bit American National Standard Code for Information Interchange (7-Bit ASCII), ANSI X3.4-1986.

(2) Input of word processing data.

(3) Input of OCR-A data, as specified in American National Standard Character Set for Optical Character Recognition (OCR-A), ANSI X3.17-1981.

(4) Input of OCR-B data, as specified in American National Standard Character Set for Optical Character Recognition (OCR-B), ANSI X3.49-1975.

(5) Input of data for other application areas. This standard leaves much latitude for negotiation between equipment manufacturers and users in these diverse areas. Only the alphabet, the numbers, and a few basic symbols are required in the keyboard arrangement.

This standard also specifies the placement of two shift keys and a space bar. However, this standard does not specify the physical characteristics and dimensions of the keys and keyboard. It relates to the keyboard arrangement only.

This standard replaces the American National Standard for Office Machines and Supplies – Alphanumeric Machines – Keyboard Arrangement, ANSI X4.23-1982.

1.2 Purpose. The purpose of this standard is to provide the greatest benefit to the user in the areas of operating, purchasing, and interchanging machines and training operators, while accommodating the various graphic character requirements of the user's applications.

2. Referenced American National Standards

This standard is intended to be used in conjunction with the following American National Standards. When these referenced American National Standards are superseded by a revision approved by the American National Standards Institute, Inc, the revision shall apply:

ANSI X3.4-1986, Information Systems – Coded Character Sets – 7-Bit American National Standard Code for Information Interchange (7-Bit ASCII)

ANSI X3.17-1981, Character Set for Optical Character Recognition (OCR-A)

ANSI X3.49-1975, Character Set for Optical Character Recognition (OCR-B)

3. Definitions

application. The use to which an information processing system is put. For example, word processing, accounting, OCR data creation, computer programming, and book publishing are applications.

case. A group of characters similarly positioned with respect to the shift.

function key. A key on the machine that, when activated, produces a machine action other than a printing impression, such as shift, back space, and the like.

graphic character. A character intended to be written, printed, or otherwise displayed in a form that can be read. It should be noted that "space" is considered a graphic character in codes for information interchange.

key (key top, keybutton). A finger-contact member, the activation of which results in a machine response.

keyboard. The area of a machine on which the printing and function keys are arrayed.

keyboard arrangement. The position of the keys relative to one another and the arrangement of characters on them.

lowercase (l/c). A group of characters, usually containing the small alphabet, numerals, and certain symbols, that are accessible with the shift key in its rest position (not depressed).

printing key. A key on the machine, the activation of which results in a graphic character being presented (e.g., printed or displayed).

shift. The facility for changing between uppercase and lowercase.

symbol. Any of the punctuation marks and signs used instead of a word or words to represent an operation, relationship, spoken sound, and the like.

uppercase (u/c). A group of characters, usually containing the capital alphabet and certain symbols that are accessible by depressing a shift key. There are two shift keys specified in this standard, providing identical operation.

4. Keyboard Arrangement

4.1 Keyboard. Figure 1 shows the base standard keyboard arrangement. A keyboard containing between 44 and 48 printing keys, arranged according to Figure 1, is in conformance with this standard, provided:

(1) It is recognized that there are many applications requiring keyboard input. The graphic characters required for these applications vary. No one keyboard arrangement can meet the needs of all applications, within the limitation of two shift levels on 48 keys. Consequently, the keys shown in Figure 1 with no graphic characters printed on them are left available for assignment to graphic characters needed by particular applications, as described in (2). Graphic characters shall be arranged on the keys according to one of the application sections of the standard.

(2) On a 48-key keyboard, either key D13 or key C12 shall be absent from the keyboard.

On a 47-key keyboard, key B00 shall also be absent from the keyboard.

On a 46-key keyboard, keys D13, C12, and B00 shall be absent from the keyboard.

On a 45-key keyboard, key E00 shall also be absent from the keyboard.

On a 44-key keyboard, key D12 shall also be absent from the keyboard.

In those cases when B00 is absent, the left shift key in B99 is extended rightward to fill the area assigned to B00.

(3) On those keys with letters of the alphabet printed on them, the lowercase of the keys is used to print or display the small letters, and the uppercase is used to print or display the capitals.

4.2 Location of Keys. This standard does not specify the location of any function keys, other than shift, that may be required on the keyboard. However, no function key may occupy the location of any of the printing keys shown in Figure 1, other than keys B00, C12, D12, and D13.

4.3 Assignment of Graphic Characters or Functions. This standard neither specifies nor prohibits the assignment of graphic characters or functions to shifts other then lowercase and uppercase of the printing keys in Figure 1. For example, in some implementations, the ASCII controls specified by ANSI X3.4-1986 are assigned to these printing keys and are accessed by using a "control shift" mechanism. This is allowed by this standard.

4.4 ASCII Keyboards. ASCII keyboards shall have either 47 or 48 of the printing keys shown in Figure 1 to conform with this standard. Intentionally, some keytops are left blank. Although the ASCII character set is standardized and must appear on the keyboard, it is recognized that, in various environments, minor variations in arrangement are of value. This standard does not preclude such variations of character arrangement on keys shown as blank. In particular, the following variations are explicitly allowed.

(1) Key B00 may be present. If so, B00 u/c contains the greater-than sign (>), and B00 l/c contains the less-than sign (<). If B00 is absent on the keyboard, the greater-than sign appears on B09 u/c and the less-than sign appears on B08 u/c. If B00 is absent, the shift key in B99 is extended rightward to fill the area assigned to B00.

If B00 is present, a duplicate comma (,), and a duplicate period (.) are assigned the B08 u/c and B09 u/c, respectively.

(2) Key D11 may have the left bracket ([) l/c and the left brace ({) u/c. Key D12 may have the right bracket (]) l/c and the right brace (}) u/c. Key D13 may have the reverse slant (\) l/c and the vertical line (|) u/c. Key C12 may be absent.

Alternatively, Key D11 may have the reverse slant (\) l/c and the vertical line (|) u/c. Key D12 may have the right bracket (]) l/c and the left bracket ([) u/c. Key D13 may be absent. Key C12 may have the right brace (}) l/c and the left brace ({) u/c.

4.5 Word Processing Keyboards. Word processing keyboard layouts shall have either 46, 47, or 48 keys. Keys, in Figure 1, shown with no graphic characters are available for assignment to meet particular user needs (see the Appendix for recommended characters and positions). Keys B00, C12, and D13 individually may be absent from the keyboard.

4.6 OCR-A Keyboards. OCR-A keyboard layouts shall have either 47 or 48 keys. Devices creating OCR-A output may have the ability to correct errors before this output is printed. Those not having this ability shall have character erase on B08 u/c and group erase on B09 u/c. With this exception, the blank keys shown may be used to provide the additional characters from the basic OCR-A repertoire and, to the extent possible, from the extended OCR-A repertoire, as specified in ANSI X3.17-1981.

4.7 OCR-B Keyboards. OCR-B keyboard layouts shall have either 47 or 48 keys. Devices creating OCR-B output may have the ability to correct errors before this output is printed. Those not having this ability shall have character erase on B08 u/c and group erase on B09 u/c. With this exception, the blank keys shown may be used to provide the additional characters from the basic OCR-B repertoire and, to the extent possible, from the extended OCR-B repertoire, as specified in ANSI X3.49-1975.

4.8 Other Applications. In other applications, keyboard arrangements comply with this standard if:

(1) The keys are arranged according to Figure 1. Any or all of the following keys may be absent: B00, C12, D11, D12, D13, E00.

(2) The graphic characters shown in Figure 1 are provided on the keyboard arrangement in the locations shown.

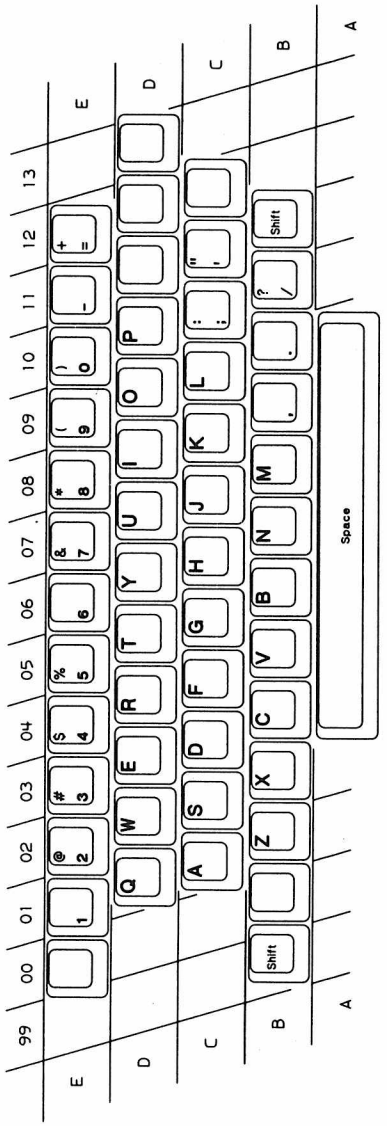


Figure 1
Keyboard Arrangement

Appendix (This Appendix is not part of American National Standard X3.154-1988, but is included for information only.)

Additional Characters Required in Some Applications

A1. Introduction

This Appendix contains information extracted from other sources, including other American National Standards, about the graphic characters required for major application areas.

A2. ASCII Data Processing

In addition to the characters placed on the keyboard in Figure 1, the ASCII character set includes the following characters:

Character	Recommended Placement
<, Less-than sign	B00 l/c or B08 u/c
>, Greater-than sign	B00 u/c or B09 u/c
[, Left bracket	D11 l/c or D12 u/c
], Right bracket	D12 l/c
{, Left brace	D11 u/c or C12 u/c
}, Right brace	D12 u/c or C12 l/c
\, Reverse slant	D13 l/c or D11 l/c
\|, Vertical line	D13 u/c or D11 u/c
~, Tilde	E00 u/c
`, Grave accent	E00 l/c
!, Exclamation mark	E01 u/c
^, Circumflex	E06 u/c
_, Underscore	E11 u/c

NOTE: The vertical line may be stylized with a break in the center (¦) for ease of recognition.

A3. Word Processing

There is no American National Standard specifying a word processing character set. The following characters are typically used on word processing equipment, in addition to the characters found on the layout in Figure 1.

Character	Recommended Placement
¶, Paragraph sign	B00 u/c (If the key is present)
§, Section sign	B00 l/c (If the key is present)
½, one-half	D12 u/c or D11 l/c
¼, one-fourth	D11 u/c
[, Left bracket	D11 l/c or D12 u/c
], Right bracket	D12 l/c
³, Superscript 3	D13 u/c or C12 u/c
², Superscript 2	D13 l/c or C12 l/c
°, Degree-sign	E00 u/c
±, Plus-minus	E00 l/c
¡, Exclamation mark	E01 u/c
¢, Cent-sign	E06 u/c
_, Underscore	E11 u/c

A4. OCR-A

In addition to the characters placed on the keyboard in Figure 1, the OCR-A character set includes the following characters:

Character	Recommended Placement
<, Less-than sign	B00 l/c or B08 u/c
>, Greater-than sign	B00 u/c or B09 u/c
[, Left bracket	D11 l/c or D12 u/c
], Right bracket	D12 l/c
{, Left brace	D11 u/c or C12 u/c
}, Right brace	D12 u/c or C12 l/c
\, Reverse slant	D13 l/c or D11 l/c
\|, Vertical line	D13 u/c or D11 u/c
⑁, OCR chair	E00 l/c
⑂, OCR hook	E00 u/c
^, Circumflex	E06 u/c
⑄, OCR fork	E11 u/c

A5. OCR-B

In addition to the characters placed on the keyboard in Figure 1, the OCR-B character set includes the following characters:

Character	Recommended Placement
<, Less-than sign	B100 l/c or B08 u/c
>, Greater-than sign	B00 u/c or B09 u/c
[, Left bracket	D11 l/c or D12 u/c
], Right bracket	D12 l/c
{, Left brace	D11 u/c or C12 u/c
}, Right brace	D12 u/c or C12 l/c
\, Reverse slant	D13 l/c or D11 l/c
\|, Vertical line	D13 u/c or D11 u/c
^, Circumflex	E06 u/c
_, Underscore	E11 u/c

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Revision and
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American National Standard
for Office Machines and Supplies –

Alphanumeric Machines – Alternate Keyboard Arrangement

Secretariat
Computer and Business Equipment Manufacturers Association

Approved April 26, 1991
American National Standards Institute, Inc.

American National Standard

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Foreword (This foreword is not part of American National Standard X3.207-1991.)

In 1982, ANSI approved American National Standard for Office Machines and Supplies–Alphanumeric Machines–Alternate Keyboard Arrangement, ANSI X4.22-1983, as an alternate standard keyboard layout, supplementing American National Standard for Office Machines and Supplies – Alphanumeric Machines – Keyboard Arrangement, ANSI X4.23-1982. A few requirements for extension and clarification have arisen, prompting the issuance of this replacement standard, ANSI X3.207-1991, which is a revision and redesignation of ANSI X4.22-1983.

ANSI X3.207-1991 offers an alternative to the keyboard presented in ANSI X3.154-1988, American National Standard for Office Machines and Supplies–Keyboard Arrangement for Alphanumeric Machines.

A few concerns had arisen with ANSI X4.22-1983, which prompted the writing of this replacement standard.

One concern was editorial in nature. There were procurement situations in which interpretation of the standard was difficult, due to the many complex relationships among text in the body of the standard, tabular material, and footnotes. Without removing the flexibility of the original standard, this new standard expresses the requirements explicitly so that the intended flexibility is unambiguous .

The second issue addressed was the human factors concerns expressed by users of the 48-key layout described in ANSI X4.23-1982. Many users found the location of the left Shift key and the Return key to be farther from the home position than they were accustomed to, with new graphic characters placed where the Shift and Return formerly were. The result was frequent miskeying of input. The new standard allows a 47-key ASCII Keyboard with both the left Shift key and the Return key in their original positions, near the home position.

Because of the existing equipment base and manufacturing tooling, this standard does not disallow any of the options allowed by ANSI X4.22-1983. In the course of time, when the improvements of this present standard become widely known and available, it is anticipated that the older equipment will be replaced with equipment that takes advantage of these improvements.

This standard supersedes ANSI X4.22-1983.

Technical Committee X3V1 (Text: Office and Publishing Systems) under the direction of the Accredited Standards Committee on Information Processing Systems, X3, was responsible for the development of this standard.

There are two annexes in this standard, both of which are informative and are not part of this standard.

Requests for interpretation, suggestions for improvement or addenda, or defect reports are welcome. They should be sent to the X3 Secretariat, Computer and Business Equipment Manufacturers Association, 311 First Street, NW, Suite 500, Washington, DC 20001-2178.

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee on Information Processing Systems, X3. Committee approval of the standard does not imply that all committee members voted for its approval. At the time it approved this standard, the X3 Committee had the following members:

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American National Standard for Office Machines and Supplies –

Alphanumeric Machines – Alternate Keyboard Arrangement

1 Scope and purpose

1.1 Scope

This standard provides a performance-oriented keyboard arrangement that is an alternative to the keyboard presented in *American National Standard for office machines and supplies – Alphanumeric machines – Keyboard arrangement*, ANSI X3.154. This standard describes the arrangement of the 48 basic printing keys on the keyboard and the characters, uppercase and lowercase, that appear on the keys. The character assignments are divided into five application areas, in recognition of the different graphic character requirements of these application areas.

The application areas this standard addresses are:

- *Input of American Standard Code for Information Interchange (ASCII) data characters.* As specified in ANSI X3.4;
- *Input of word processing data;*
- *Input of OCR-A data.* As specified in ANSI X3.17;
- *Input of OCR-B data.* As specified in ANSI X3.49;
- *Input of data for other application areas.* This standard leaves much latitude for negotiation between equipment manufacturers and users in these diverse areas. Only the alphabet, the numerals, and a few basic symbols are required in the keyboard arrangement.

This standard also specifies the placement of two shift keys and a space bar. However, this standard does not specify the physical characteristics and dimensions of the keys and keyboard. It relates to the keyboard arrangement only.

This standard supersedes the *American National Standard for office machines and supplies–Alphanumeric machines–Alternate keyboard arrangement*, ANSI X4.22-1983.

1.2 Purpose

The purpose of this standard is to provide the greatest benefit to the user in the areas of operating, purchasing, and interchanging machines and training operators, while accommodating the user's applications' various graphic character requirements.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ANSI X3.4-1986, *Information systems–Coded character sets–7-bit American National Standard code for information interchange (ASCII)*

ANSI X3.17-1981 (R1989), *Character set for optical character recognition (OCR-A)*

ANSI X3.49-1975 (R1989), *Character set for optical character recognition (OCR-B)*

3 Definitions

Some of the definitions listed below are taken from *American National Standard for information systems–Dictionary for Information Systems,* ANSI X3.172-1990.

3.1 application: A particular kind of work that a user performs on a computer; for example, a payroll application.

3.2 function key: A key on the machine that, when activiated, produces a machine action other than a printing impression. For example, shift, back space, etc. are function keys.

3.3 graphic character: A character intended to be written, printed, or otherwise displayed in a form that can be read. It should be noted that "space" is considered a graphic character in codes for information interchange.

3.4 key (key top, keybutton): A finger-contact member the activation of which results in a machine response.

3.5 keyboard: The area of a machine on which the printing and function keys are arrayed.

3.6 keyboard arrangement: The position of the keys relative to one another and the arrangement of characters on them.

3.7 lowercase (l/c) characters: A group of characters, usually containing the small alphabet, numerals, and certain symbols, that are accessible with the shift key in its rest position (not depressed).

3.8 printing key: A key on the machine, the activation of which results in a graphic character being presented (e.g., printed or displayed).

3.9 shift: The facility for changing between uppercase and lowercase.

3.10 symbol: Any of the punctuation marks and signs used instead of a word or words to represent an operation, relationship, spoken sound, etc.

3.11 uppercase (u/c) characters: A group of characters, usually containing the capital alphabet and certain symbols that are accessible by depressing a shift key. There are two shift keys specified in this standard, providing identical operation.

4 Alternate Keyboard Arrangement

4.1 Arrangement

Figure 1 shows the base standard alternate keyboard arrangement. A keyboard containing between 44 and 48 printing keys, arranged according to Figure 1, is in conformance with this standard provided that

a) It is recognized that there are many applications requiring keyboard input. The graphic characters required for these applications vary. No one keyboard arrangement can meet the needs of all applications, within the limitation of two shift levels on 48 keys. Consequently, the keys shown in Figure 1 with no graphic characters printed on them are left available for assignment to graphic characters needed by particular applications, as described in 4.1 (b). Graphic characters shall be arranged on the keys in accordance with 4.4 – 4.7.

b) On a 48-key keyboard, either key D13 or key C12 shall be absent from the keyboard.

On a 47-key keyboard, key B00 shall also be absent from the keyboard.

On a 46-key keyboard, keys D13, C12, and B00 shall be absent from the keyboard.

On a 45-key keyboard, key E00 shall also be absent from the keyboard.

On a 44-key keyboard, key D12 shall also be absent from the keyboard.

When B00 is absent, the left shift key in B99 is extended rightward to fill the area assigned to B00.

c) In figure 1, the keys labeled with the letters of the alphabet are intended to produce lowercase letters in the unshifted (lowercase) mode and uppercase letters in the shifted (uppercase) mode. The other keys are intended to produce the lower character shown on the key in the unshifted mode, and the upper character shown on the key in the shifted mode.

4.2 Location

This standard does not specify the location of any function keys (other than Shift) that may be required on the keyboard. However, no function key may occupy the location of any of the printing keys shown in figure 1, other than keys B00, C12, D12, and D13.

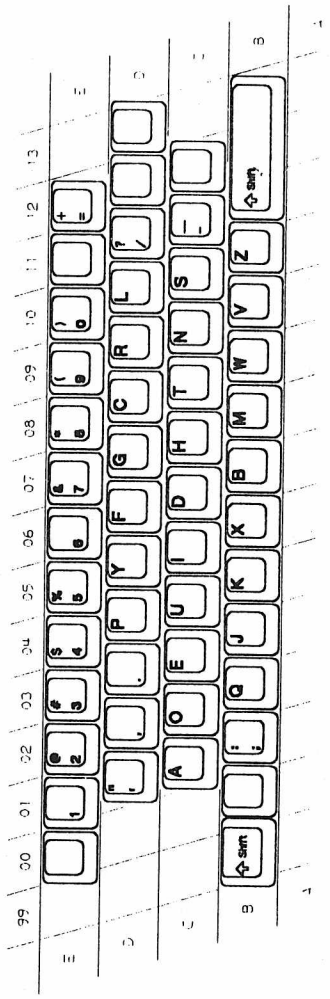


Figure 1 – Alternate keyboard arrangement

4.3 Assignment

This standard neither specifies nor prohibits the assignment of graphic characters or functions to positions other than lowercase and uppercase of the printing keys in figure 1. For example, in some implementations, the ASCII controls specified by ANSI X3.4 are assigned to these printing keys and are accessed by using a "control shift" mechanism. This is allowed by this standard.

4.4 ASCII Keyboards

ASCII keyboards shall have either 47 or 48 of the printing keys shown in figure 1 to conform with this standard. Intentionally, some keytops are left blank. Although the ASCII character set is standardized and shall appear on the keyboard, it is recognized that, in various environments, minor variations in arrangement are of value. This standard does not preclude such variations of character arrangement on keys shown as blank. In particular, the following variations are explicitly allowed:

a) Key B00 may be present. If so, B00 u/c contains the greater-than sign (>), and B00 l/c contains the less-than sign (<). If B00 is absent on the keyboard, the greater-than sign appears on D02 u/c and the less-than sign appears on D03 u/c. If B00 is absent, the shift key in B99 is extended rightward to fill the area assigned to B00.

If B00 is present, a duplicate comma (,) and a duplicate period (.) are assigned the D02 u/c and D03 u/c, respectively.

b) Key D12 may have the left bracket ([) l/c and the left brace ({) u/c. Key D13 may have the right bracket (]) l/c and the right brace (}) u/c. Key C12 may be absent.

Alternatively, key D12 may have right bracket (]) l/c and left bracket ([) u/c. Key D13 may be absent. Key C12 may have the right brace (}) l/c and the left brace ({) u/c.

4.5 Word processing keyboards

Word processing keyboard layouts shall have either 46, 47, or 48 keys. Keys shown with no graphic characters are available for assignment to meet particular user needs. See annex A for recommended characters and positions. Keys B00, C12, and D13 individually may be absent from the keyboard.

4.6 OCR-A keyboards

OCR-A keyboard layouts shall have either 47 or 48 keys. Devices creating OCR-A output may have the ability to correct errors before this output is printed. Those not having this ability shall add Character Erase to D02 u/c and Group Erase to D03 u/c. With this exception, the blank keys shown may be used to provide the additional characters from the basic OCR-A repertoire and, to the extent possible, from the extended OCR-A repertoire, as specified in ANSI X3.17-1981.

4.7 OCR-B keyboards

OCR-B keyboard layouts shall have either 47 or 48 keys.

Devices creating OCR-B output may have the ability to correct errors before the output is printed. Those not having this ability shall add Character Erase to D02 u/c and Group Erase to D03 u/c. With this exception, the blank keys shown may be used to provide the additional characters from the basic OCR-B repertoire and, to the extent possible, from the extended OCR-B repertoire, as specified in ANSI X3.49.

4.8 Other applications

In other applications, keyboard arrangements comply with this standard if:

- The keys are arranged according to figure 1. Any or all of the following keys may be absent: B00, C12, D12, D13, E00;
- The graphic characters shown in figure 1 are provided on the keyboard arrangement in the locations shown.

Annex A
(informative)

Additional characters required in some applications

A.1 Introduction

This annex contains information extracted from other sources, including other American National Standards, about the graphic characters required for major application areas.

A.2 ASCII data processing

In addition to the characters placed on the keyboard in figure 1, the ASCII character set includes the following characters:

Character		Recommended Placement
<,	Less-than sign	B00 l/c or D02 u/c
>,	Greater-than sign	B00 u/c or D03 u/c
[,	Left bracket	D12 l/c or D12 u/c
],	Right bracket	D13 l/c or D12 l/c
{,	Left brace	D12 u/c or C12 u/c
},	Right brace	D13 u/c or C12 l/c
\,	Reverse slant	E11 u/c
\|,	Vertical line	E11 l/c
~,	Tilde	E00 u/c
`,	Grave accent	E00 l/c
!,	Exclamation mark	E01 u/c
^,	Circumflex	E06 u/c
_,	Underscore	C11 u/c

A.3 Word processing

There is no American National Standard specifying a word processing character set. The following characters are typically used on word processing equipment, in addition to the characters found on the layout in figure 1.

Character		Recommended Placement
¶,	Paragraph sign	B00 u/c (If the key is present)
§,	Section sign	B00 l/c (If the key is present)
½,	one-half	E11 l/c
¼,	one-fourth	E11 u/c
[,	Left bracket	D12 l/c or D12 u/c
],	Right bracket	D13 l/c or D12 l/c
^{3},	Superscript 3	D13 u/c or C12 u/c
^{2},	Superscript 2	D12 u/c or C12 l/c
°,	Degree-sign	E00 u/c
±,	Plus-minus	E00 l/c
!,	Exclamation mark	E01 u/c
¢,	Cent sign	E06 u/c
_,	Underscore	C11 u/c

A.4 OCR-A

In addition to the characters placed on the keyboard in figure 1, the OCR-A character set includes the following characters:

Character		Recommended Placement
<,	Less-than sign	B00 l/c or D02 u/c
>,	Greater-than sign	B00 u/c or D03 u/c
[,	Left bracket	D12 l/c or D12 u/c
],	Right bracket	D13 l/c or D12 l/c
{,	Left brace	D12 u/c or C12 u/c
},	Right brace	D13 u/c or C12 l/c
\,	Reverse slant	E11 u/c
\|,	Vertical line	E11 l/c
⊓,	OCR chair	E00 l/c
∩,	OCR hook	E00 u/c
^,	Circumflex	E06 u/c
ϒ,	OCR fork	C11 u/c

A.5 OCR-B

In addition to the characters placed on the keyboard in Figure 1, the OCR-B character set includes the following characters:

Character		Recommended Placement
<,	Less-than sign	B00 l/c or D02 u/c
>,	Greater-than sign	B00 u/c or D03 u/c
[,	Left bracket	D12 l/c or D12 u/c
],	Right bracket	D13 l/c or D12 l/c
{,	Left brace	D12 u/c or C12 u/c
},	Right brace	D13 u/c or C12 l/c
\,	Reverse slant	E11 u/c
\|,	Vertical line	E11 l/c
^,	Circumflex	E06 u/c
_,	Underscore	C11 u/c

Annex B
(informative)

Bibliography

ANSI X3.154-1988, *Office machines and supplies–Alphanumeric machines–Keyboard arrangement*

ANSI X3.172-1990, *Information systems–Dictionary for information systems*